FIELD MUSEUM OF NATURAL HISTORY BULLETIN

January 1983

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Field Museum of Natural History Bulletin

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COVER

Table cover made in western India, AD 1700-1850. Made for use in India. This remarkable piece will be on view in Hall 27 beginning January 29 (Members' preview Jan. 28) as part of the exhibit "Master Dyers to the World: Early Fabrics from India." For more on Indian dyers' art see pp. 12-25.

This piece looks a bit like patchwork but is made from a single, uncut cloth. It may have functioned as a sampler, showing many different single-flower block stamps and a marvelous range of subtle earth-tone colors.

The dyer made it using only a few dyes but many brief immersions in the vat, each time taking it out, drying it, covering another triangle or two with wax (or a similar resist), and then dipping it back in again. The fact that the resulting series of colors have not faded into each other in all this time is a testimony to the remarkable fastness of early Indian natural dyes. Permanent yellows are said to have been particularly hard to achieve before the development of synthetic coal tar and petroleum dyes in the late 19th century.

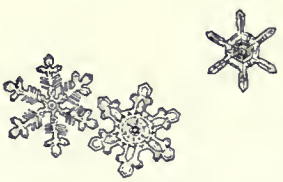
The flowers are naturalistic enough that most could probably be identified by someone with a good knowledge of the desert wild and garden flowers of Rajasthan, where these cloths were made.

Dyed cotton, with stamped (and brushed-on?) mordants and resist. National Museum, New Delhi 56.48/12.

Field Museum is grateful to Garamond/Pridemark Press, Inc., of Baltimore Maryland, and to the Textile Museum, Washington, D.C. for the use of color transparencies to produce color plates on the cover and on pages 12-18.

Workshops for Children 1983

Children ages 4 to 12 are invited to explore Field Museum's collections in a series of exciting weekend workshops



Saturday, January 8

"AN ESKIMO WINTER": See how Eskimo children adapt their fun to the indoors: play their games and make your own Eskimo doll!
Ages 4-5; 10am to 12 noon. Members: $6, nonmembers: $8.

"ROYAL AFRICAN BANNERS": Hear legends about these symbols and use colorful stamps to make your own banner or tie-dye fabric.
Ages 6-7; 1 to 3pm. Members: $8, nonmembers: $10.

"DINOSAUR MURAL": With your class, paint a giant dinosaur mural and make a small dinosaur drawing into a button to wear home!
Ages 6-7; Saturdays, Jan. 8 and 15, from 10am to 12 noon. Members: $14, nonmembers: $16.

"LEGEND OF THE WHITE SNAKE LADY": Find out about this ancient folk art, learn to make shadow figures from Chinese legends, and join together to give your own shadow play.
Ages 8-9; 10am to 12 noon. Members: $8, nonmembers: $10.

Sunday, January 9

"THUNDER LIZARDS": Learn about dinosaur sizes and habits and make your own stuffed prehistoric pal.
Ages 4-5; 10am to 12 noon. Members: $8, nonmembers: $10.

"CELEBRATED JUMPING FROG OF CALAVERAS COUNTY": Hear the calls of various frogs and learn about their life stages —egg, to tadpole, to adult.
Ages 6-7; 10am to 12 noon. Members: $6, nonmembers: $8.

"JOURNEY THROUGH TIME": Examine trilobite, dinosaur, and woolly mammoth fossils and make a giant time-line trail through the Museum halls!
Ages 6-7; 1 to 3pm. Members: $6, nonmembers: $8.

"DIARY OF AN INDIAN WARRIOR": Find out about the lives of the Sioux, Cheyenne, and Kiowa; build your own tipi to set up camp.
Ages 8-9; 1 to 3pm. Members: $8, nonmembers: $10.

"DECODING THE ROSETTA STONE": Study a facsimile of this mysterious stone and create your own Egyptian stela rubbing.
Ages 10-12: 10am to 12 noon. Members: $6, nonmembers: $8.

Saturday, January 15

"GIANTS—YESTERDAY AND TODAY": Compare today's giants with yesterday's and find out how they cope with their huge size.
Ages 4-5; 10am to 12 noon. Members: $6, nonmembers: $8.

"SPIRIT AND ANIMAL DANCERS": Listen to myths that enliven Indian ceremonies, create your own myth, dance, and music.
Ages 6-7; 1 to 3 pm. Members: $6, nonmembers: $8.

"A BOOK OF MYTHICAL TALES": Look at slides of scientific drawings of real animals. Choose your favorite, then paint a fantasy creature that you write a story about.
Ages 6-7; 1 to 3 pm, Saturdays, Jan. 15 and 22. Members: $12, nonmembers: $14.

"FILMMAKING": Using archival photographs and exhibit halls, the group makes Super 8 film documenting the construction of the Museum building and the collection and display of the Museum's many famous exhibits.
Ages 7-9; Saturdays, Jan. 15, 22, and 29; 1 to 3pm. Members: $22, nonmembers: $25.

"KI-AIKIDO": Exercises that aid the coordination of mind, body, and breathing introduce you to the art of *ki-aikido.*
Ages 8-9; 10am to 12 noon. Members: $6, nonmembers: $8.

"BOTANIC ILLUSTRATION": Students learn to use microscopes and drawings tools in examining a dried plant, then create a part of that specimen.
Ages 10-12; 1 to 3pm. Members: $8, nonmembers: $10.

Saturday, January 22

"JUNGLE UNDER GLASS": Discover the world of plants: build a miniature tropical rain forest.
Ages 4-5; 10am to 12 noon. Members: $8, nonmembers: $10.

"ANIMAL ACCESSORIES": Learn about special adaptations of animals by discussing and imitating their ways of life.
Ages 6-7; 10am to 12 noon. Members: $8, nonmembers: $10.

"ROCK AND ROLL": Answer important questions about rocks and minerals through lab experiments and a tour of geology exhibits.
Ages 8-9; 10am to 12 noon. Members: $6, nonmembers: $8.

"A NIGHT IN THE FIELD": Camp out inside Field Museum! Let museum staff introduce you to the world of Field Museum. Snacks and breakfast included.
Ages 9-10; Saturday, Jan. 22, 6:30pm to Sunday, Jan 23, 9am. Saturday, Jan. 29, 6:30pm to Sunday, Jan 30, 9am. Members: $22, nonmembers: $25.

"IN PURSUIT OF THE PAST": Learn how artifacts are dated, reconstructed, and analyzed by working in a lab, then draw conclusions from your findings.
Ages 10-12; 1 to 3pm. Members: $8, nonmembers: $10.

Saturday, January 29

"NIGHTTIME HUNTERS—OWLS": Learn about these fascinating birds and make your own bean bag snowy owl.
Ages 4-5; 10am to 12 noon. Members: $8, nonmembers: $10.

"SOMETHING FISHY": Find out about walking catfish, electric fish, and megamouth (a new shark species) and their unique adaptations.
Ages 6-7; 1 to 3pm. Members: $6, nonmembers: $8.

"PASSAGE TO INDIA": After touring Field Museum's new exhibit, "Master Dyers to the World," learn about resist-dyeing technique and create your own designs.
Ages 8-9; 10am to 12 noon. Members: $8, nonmembers: $10.

"FRIEND OR FOE": Learn to appreciate misunderstood animals; track their geographic locations.
Ages 8-9; 1 to 3pm. Members: $6, nonmembers: $8.

FAMILY FEATURE: "STRATEGIES FOR A COLD CLIMATE": Meet at the North Information Booth at 1:00pm and tour the Museum's exhibits to learn how animals prepare for winter hardships. Learn to make suet and seed treats for winter wildlife. This program is *free*; no tickets required.

Saturday, January 15

"Winter Critters": What do animals do in winter?

Sunday, January 16

"Birds in My Backyard": Know the birds that winter in or near Chicago.

EXHIBIT OPENING: "Master Dyers to the World: Early Fabrics from India" features rare, beautiful cloths from 15th-18th century India.

Members' preview: From 5 to 7pm on Friday, January 28. Special guest for the preview will be Dr. Mattiebelle Gittinger, guest curator and author of the exhibit catalog. Dr. Gittinger will be in the *Museum Store* for an autograph session from 5:15 to 6:00pm. From 6:15 to 6:45 she will deliver an exhibit slide lecture in Lecture Hall 1.

The public opening for this exhibit is Saturday, January 29.

MUSEUM HOURS: 9:00am to 5:00pm daily (closed New Year's Day)
MUSEUM TELEPHONE: (312) 922-9410
WEEKEND EVENTS: (312) 322-8854

Complete coupon and mail with check payable to "Field Museum"

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Date Received

Date Returned

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City State Zip

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Child's Name (last name first)	Age	Workshop Title	Member	Nonmember	Amount Enclosed
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FIELD BRIEFS

Austin L. Rand 1906-82

Former Field Museum curator Austin Loomer Rand (right) died November 6 in Avon Park, Florida; he was 76 years old. A world renowned ornithologist, Rand served on the Field Museum staff from 1947 to 1970, his final post being chief curator of Zoology. Following his retirement he moved to Lake Placid, Florida.

A native of Nova Scotia, Rand's field work took him to Madagascar, the Philippines, and to New Guinea. Before joining the Field Museum staff he was with the American Museum of Natural History in New York (1929-42) and with the National Museum of Canada (1942-47). He wrote a number of popular as well as technical books on birds, and frequently contributed articles to the *Bulletin*. His popular work *Ornithology: An Introduction* appeared in 1967.

Rand is survived by his wife, Rheua; two sons, Stanley and William; and four grandchildren.

50 Millionth Visitor Returns

E. Leland Webber, president emeritus of Field Museum, had a surprise visit to his office on November 19 by John M. Witte, a life member now of Tulsa, Oklahoma. On July 2, 1962, Witte, then twelve years old, became the 50 millionth visitor to Field Museum (then known as Chicago Natural History Museum), and Webber, then director, presented him with a life membership certificate. Witte's parents, Mr. and Mrs. John S. Witte, of suburban Westchester, are also Field Museum members and are frequent visitors to the Museum.

Shown below are E. Leland Webber and John M. Witte in 1962 (left) and 1982.

World Wildlife Evening, Prince Philip Presides

A NOVEMBER 8 SYMPOSIUM at Field Museum on "Tropical Forests: Vanishing Cradle of Diversity" was the occasion for a visit by Prince Philip, Duke of Edinburgh, president of World Wildlife Fund-International, who served as symposium chairman. A reception and dinner followed the symposium in Stanley Field Hall. Shown here are the prince and some of the evening's guests.

From top left, clockwise: Mrs. Edwin J. DeCosta, Prince Philip; Mr. James J. O'Connor, Mrs. and Dr. Willard L. Boyd; The Honorable Jane Byrne, Prince Philip, Mrs. T. Stanton Armour, Mr. Russell Train; Dr. Boyd; Mrs. Armour, Prince Philip, Mrs. James J. O'Connor, Mrs. Harry O. Bercher; Dr. Edward A. Newman, Mr. Arthur Rubloff, Mrs. Robert A. Pritzker; Dr. Edwin J. DeCosta, Mrs. Armour, Prince Philip, Mrs. DeCosta.

A Layman's Guide to Resources, Reserves, and Recovery

by Edward Olsen
Curator of Mineralogy

Dark as a Dungeon

It's dark as a dungeon, and damp as the dew,
The dangers are double, the pleasures are few,
Where the rain never falls, and the sun never shines,
It's dark as a dungeon, way down in the mines.

—M. Travis

Many years ago I worked in a mine. I did it for less than a year, but the experience was unforgettable.

Miners work hard, in a dark, hazardous environment. I got to know a lot of men who have been miners for life. They are hardy, fatalistic, and superstitious—like seamen. I heard tales of mines 9,000 feet deep, where the drifts (tunnels) through the ore creak and groan as the rock walls slowly sag inward to finally fill the open space that cannot be permanently supported at that depth. The strategy is to keep the drifts moving, backfill with waste rock, and let them cave in behind you. Mines at such depths are beastly hot and bone dry.

My mine was only 1,100 feet deep. The drifts were wet—ankle deep with cold water, and the walls and ceilings oozed and dripped a constant shower of water. The cold, dank air was laden with the smell of crushed rock and stale dynamite. Half a dozen times a day I would hear a series of short whistle notes, a miner's voice shouting, *"Blast, blast, blast!!!"* followed by a resounding deep thump that rumbled through the rock, and a sudden rush of hot air that roared down the drift. They had just dynamited a mass of ore.

As I used to slosh along the drifts, the light on my hard hat piercing the damp darkness, picking out the twists, turns, and dead ends, I recall wondering how many of the people who live up on the surface of this planet have any idea what goes on down here, and how they get the products they use. Now, years later, I've decided practically no one has any idea what this is about.

Even today, sometimes as I look around a room I can't help ticking off in my mind the vast number of products and devices we take for granted that are made from minerals hard won by miners: all the metals of our cars and homes, glass, all electrical appliances, computers, transistors, lighting, TV sets, bricks, fertilizers for the foods we eat, and on and on—everything that is not made of wood or natural fibers.

There is a good deal of misinformation about mineral resources, and this is especially troubling when the misinformed are legislators, administrators, bureaucrats, and political candidates. It is easy to state half truths about mineral resources, or make statements that are both true and false at the same time.

Some years ago I recall hearing a councilman of a suburb near Chicago say that water resources would never be a problem for his village because "a subterranean river from Lake Superior flows right under the village." This is absolutely wrong, of course. At some time in his past real facts were mixed up, and this "fact" was the result. In that particular case a sandstone formation below that village (and hundreds of other municipalities in Illinois, Wisconsin, Michigan, and Iowa) carried groundwater that entered the sandstone, where it outcropped, as soaked-in rain, in central Wisconsin—not Lake Superior! Dipping gently southward from Wisconsin, the sandstone lies almost 2,000 feet below that particular village. The recharge rate and flow rate are so slow that a few dozen villages pumping from deep wells would soon exhaust it. Worse yet, due to chemicals in the sandstone a large portion of the water is unusable. Nevertheless, this bit of "knowledge" had its effect on this politician's voting record in matters of water use in his village.

Over the past dozen years two presidential candidates have made a particular statement which is true, but misleading: Of the petroleum in the United States that was here when the Pilgrims landed, about half remains in the ground. We need only apply the right incentives to get it pumped out. In other words, we've only used about half the petroleum. The rest is still down there waiting to be had. The statement is true—however, too simplistic. It's more complicated than that.

Such a statement makes oil companies look bad in the eyes of the public. If there is an amount of oil about equal to what we've already used, why are they sitting on it? Why are we (the USA) left vulnerable to the whims and politics of the

OPEC nations when we could be totally independent of them? To understand this we have to look at the average oil deposit.

Contrary to popular belief, oil "pools" are not pools at all. When an oil geologist talks about pools *he* knows what he means, but the word carries a popular image of a kind of underground cavity filled with well mixed oil, like the stuff that comes out of a can in your friendly filling station. A still somewhat simplified, but more correct image, is that of oil droplets filling the tiny pore spaces between mineral grains. In many untapped "pools" the oil is charged with methane gas, just as a carbonated drink is charged with carbon dioxide. When the methane pressure is high and the oil drill hits the layer of rock holding the oil, you get the "gusher" made famous in old movies. It's just like opening a bottle of champagne, or shaking up a coke. In cases where the methane pressure is lower, as it is most of the time, the oil can be readily pumped up from considerable depth, driven upward by the pressure of the gas, along with the suction of the pumping system. As times goes by, this natural gas charge is lost, the viscosity increases, and pumping becomes more difficult.

Another factor also comes into play. Oil is not a single product. It consists of a mixture of light to heavy fractions that can span a range from thin and almost watery, to thick, tarry, and mudlike in consistency. Some oil fields have high fractions of lightweight oils and some are mainly heavy oils. Taking all oil deposits together, roughly half is light and easily pumped, and half is dense and pumping is impossible.

Oil companies make every attempt to get all the oil out of a given field by straight pumping. This is called *primary recovery*, and is the cheapest oil to produce. When the lightest fractions have been gotten, the next technique is to try fracturing and water flooding. This uses the fact that oil will float on water. A second hole is drilled down to the oil-bearing layer. Water is force-pumped down this hole. Some of the remaining oil is dislodged by the water and the mixture of oil and water is pumped out of the original production well. This process is called *secondary recovery*. As a rough national average, at this stage about half the original oil in the deposit has been obtained. The remaining half consists of tarry, sticky oil that cannot be dislodged from between mineral grains in the rock. At this point the oil field may be considered effectively dead. It is this half of the original oil, politicians imply, that can be gotten with the right incentives.

There are ways to obtain this remaining oil —but at a high cost. The least desirable of these is to put in an underground mine, mine out the rock, bring it to the surface, crush it, heat it (which uses energy) and distill out the oil. This is the expensive method that has been used to remove oil from the much talked-about "oil shales" and "tar sands." The other method is to pump down a complex mixture of chemicals called surfactants and detergents. They release the sticky oils from the mineral grains and suspend them in an emulsion which can be pumped to the surface. The chemicals that are needed for this process, which is called *tertiary recovery*, are expensive to produce.

On top of all this, there is still another consideration. Most refineries, which turn oil into such finished products as gasoline, are designed to handle oils of light to medium weight. In order to refine the heavy oils obtained by tertiary recovery major new investments must be made in refining equipment.

The end result is that the methods necessary to remove the remaining half of the oil in the USA are very expensive. Translated into the price you pay for gasoline or heating oil, OPEC oil (most of which involves secondary recovery at most) is vastly cheaper.

Turning from the oil industry, there are two other general words bandied about the mineral industry—words often used incorrectly: *reserve* and *resource*. It's common to hear them used interchangeably by political and business leaders and by members of the communications media. They are, actually, not interchangeable.

A *reserve* is an amount of a natural mineral product—such as metallic ore, petroleum, coal, water, industrial stone, etc.—that can be measured in tons (or barrels) and *is known to exist*. In addition, the mineral must be producible with existing technology at a cost that is not prohibitive on the current marketplace.

There are several levels of confidence involved in knowing the amount of a given reserve. Ore in the ground (or oil, or water, etc.), for example, can be measured with reasonable accuracy by a combination of geophysical and geochemical methods, along with direct observation of drill cores that have been made. These are called *measured reserves*, and can be spoken about with great confidence in matters of national planning, price structures, markets, and politicking.

Then there are *indicated reserves*. These are based on limited and widely spaced measurements of ore in the area surrounding the measured reserves. The supposition is that a few random samples, combined with some mapping, can indicate whether a significant amount of ore extends beyond the measured reserve area. Back when I worked in a mine I was involved in the mapping that led to estimates of indicated reserves. Indicated reserves can be

talked about with less confidence.

Finally, there are what is called *inferred reserves*. These are projections of ore possibilities into broad regions surrounding an ore body based on the general geological character of the type of ore and on the mining history of similar ore bodies elsewhere in the world. Few or no samples are taken. Such reserves can be spoken of with little confidence.

On top of these three degrees of knowledge about a given ore body (or oil "pool"), there is superimposed the consideration of economic reserves. Suppose, for example, you have an iron ore deposit with a measured reserve of 700 million tons. Your chief user is, perhaps, a single auto company. Based on your sales to that manufacturer the reserves should last a comfortable 36 years. Suddenly there is a boom in auto production. The projected life of your mining company drops effectively to 9 years because of the increased demand. A mining company in such a spot will go into a panic. Its economic lifetime has decreased to an unacceptably short period. This has exactly the same result on the company as if it suddenly discovered that it had made a bad assessment of its measured reserve by a factor of four.

Another economic factor can also come into play in certain ores. For example, suppose a copper mine opened in 1880 and mined ore that contained 4 percent copper—a very rich mine by modern standards. In terms of 1880 mining practices if the ore grade fell below 1 percent copper it could not be profitably mined. A hundred years later, however, mining methods have improved to the point where 0.02 percent copper can be extracted fairly easily. In the 1980s, however, other costs have risen and an ore body with as little as 0.02 percent copper wouldn't be enough to justify starting a new mine. A start-up consists of more than tunnelling into the rock. It involves mine buildings, crushers, and ore-processing equipment, ore concentration equipment and buildings to house it, housing for miners and their families, and a fleet of costly ore-carrying trucks. The capital investment is huge. If, however, there is an existing mine, and the ore grade keeps getting leaner and leaner, down to 0.02 percent, this low grade can be

Continued on p. 25

FIELD MUSEUM STORE'S hefty (20 oz.), life-size apples would bring more than $6,500 each if they were actually of gold, but these stunning brass look-alikes are available to you now at just $28 each (less member's 10% discount)—the perfect paperweight, table decoration, or conversation piece. The carved wooden bowl is Philippine ($17).

These and thousands of other gifts for that special person in your life can be found in Field Museum Store's own exotic collection from around the world.

Open daily, 9:00am to 5:00pm.

TOURS FOR MEMBERS

M E Rada

Grand Canyon Adventure

May 27 - June 5
$1,600

An exciting 280-mile cruise down the Colorado River by motorized rubber raft, camping outdoors under the stars. Dr. Bertram G. Woodland, curator of petrology, will lead the tour. Group limited to 25. For additional information call (322-8862) or write the Tours Office.

The following account of Field Museum's 1981 Grand Canyon trip was written by participant Gail Richardson:

I grew up in the city and never considered roughing it. When the letter came from the Field Museum announcing a white-water rafting trip down the Colorado River through the Grand Canyon I was horrified to hear my husband of 21 years gleefully announce, "We're going, of course!"

"Rapids? Sleeping *outside*?" I croaked. "Never!"

Two months later on a blazing mid-July day I stood on the beach at Lees Ferry, Arizona, surveying with dismay the two 37-foot rubber rafts which were to transport our group to Lake Mead on the down side of some of the roughest rapids in the world. Our leader, a charming geologist from the Field Museum, made me almost ashamed of my terror since he was making the trip with a broken collarbone and cracked ribs received in a mugging six days before. Seeing his bravery I decided I could at least *pretend* to enjoy myself for the next nine days. To my amazement pretending wasn't necessary. I had the adventure of my life and became a convert to camping.

I discovered the skyscraper doesn't exist that can rival the Canyon spires, slashed with hotly glowing colors. No luxury hotel anywhere can provide a suite as glorious as the Canyon at night. Lying on the top of my sleepingbag with no bugs to pester me I watched the stars arrange themselves across the inky sky in their ageless constellations. I hadn't known they could sparkle so brilliantly.

I, who had dreaded the rapids, joined those who rode in front, yelping in delight as we catapulted into foaming torrents and roaring with laughter when we got drenched in 55 degree water. You dried in ten minutes, anyhow! Quickly, I forgot to wonder what my hair looked like and chuckled with the others about our bedraggled state.

No opulent spa or resort pool can stand comparison to the springs and natural pools tucked within the inner Canyon. Where water exists the desert retreats, and we were enchanted to find ferns and plants in profusion surrounding a cascade or feathering the outlines of breathtakingly clear, sun-warmed water where we frolicked and dove and knew we had come close to paradise.

An Industrial Miracle in a Golden Age: The 17th-Century Cloth Exports of India

by BENNET BRONSON

Associate Curator, Asian Archaeology and Ethnology

Exhibition, "Master Dyers to the World: Early Fabrics from India," opens January 29 in Hall 27

Japanese-style morning gown. AD 1700-50. Southeastern India. Made for sale in Europe

This shows, brilliantly, how to shape a textile pattern so that it can be tailored into a specific garment. The great pine tree grows from a rocky mound at the back and spreads up to the shoulders, along the sleeves, and around to the front. The dyed pattern perfectly matches the form of the finished coat.

It was made for a European market, yet the layout and the twisted pine motif are classically Japanese. It seems almost certain that the Indian designer had seen a real kimono from Japan, probably brought to the Coromandel Coast (that part of India south and just north of Madras) by Dutch traders in the late 17th century. That Japanese designs were already influencing European tastes in 1700, long before Commodore Perry and the great Japan craze of the late 19th century, is one of the surprises of this show.

Dyed cotton, with brushed-on mordants and drawn resist. Royal Ontario Museum, Toronto. 9959.112.

Palampore Bedcover. AD 1700-50. → Southeastern India. Made for sale in Europe.

With its large center medallion and corner segments, the basic layout of this palampore resembles a Persian carpet; but the filler design looks Japanese or Okinawan. Notice how the (Indian-type) birds are sometimes cut off by the curves of the rose-colored meander pattern: a playful design concept that is typically Japanese. The designer of this piece clearly knew the textiles of several other countries. His genius lay in his ability to adapt, reinterpret, and combine these into new forms.

Dyed cotton, with brushed-on mordants and drawn resist. Gemeentemuseum de Hidde Nijland Stichting, Hindeloopen, Netherlands 131

At the end of January, a new special exhibition, "Master Dyers to the World," opens at Field Museum for a three-month run. The subject of the show is cloth, much of it of cotton, most of it two to three hundred years old, and all of it woven and dyed in India. Some pieces were once very cheap; others were worn by kings. In a number of ways, they—or rather, they and the hundreds of millions of cloths like them that have now vanished—may be the most important of all textiles.

A glance at those illustrated here will reveal one of the reasons why this is so. Many are astonishingly beautiful, made with a skill in handling fiber and natural dyes that may never have been equalled. The exhibition includes no fewer than six of the ten-odd Indian cloths that are known to have survived from the 17th century, a golden age when the prestige and skill of Indian textile artists are said to have reached heights never attained before or since. Two of the cloths in the exhibition, the Brooklyn Museum Hanging and the Riboud Textile (both of which are too large and detailed to be illustrated here) are actually famous. Several are so brilliantly designed and flawlessly made that they may well rank among

← Wall hanging with Dutchmen. AD 1640-50. Southeastern India. Made for use in India.

Among the more important surviving 17th-century Indian cloths, this is interesting both for its depictions of Dutch and Indo-Persian costumes and for its architectural format. The costumes appear to be historically accurate; similarities between these and costumes in Persian and Dutch paintings are what make such a precise dating possible. The superposed pavilions framing individuals in formal poses are a characteristic of the art style of Vijayanagar, the great South Indian empire that was destroyed shortly before this cloth was made.

The European fondness for dogs was a trait that fascinated Asians during the 16th and 17th centuries. Numerous Indian and Japanese pictures of that period show European traders with dogs and other pets on laps, on shoulders, or under chairs and tables. This particular dog is about to knock over an Indian bottle and a glass sweets dish imported from Venice.

Dyed cotton, with drawn and brushed-on resist and mordants. Victoria and Albert Museum, London 687-1898.

Aquatic scene on cloth fragment. AD 1600-1700. India. Made for use in India.

This is all that remains of what must have been a most interesting pictorial hanging. The skillfully drawn cartoonlike figures were dyed in an unusual number of colors, and this, plus the liberal use of gold tinsel, indicates a high price. However, its function is not known. Would such a scene have appealed to early European traders, generally a humorless lot? But then, who was it made for? Is there an Indian myth or legend that includes a man eaten by a sea monster, another man swimming in a lotus pond, and small tame land monsters with their individual food bowls?

As far as is known, no other cloth like it survives.

Dyed cotton, with brushed-on and drawn mordants and resist, applied tinsel. Textile Museum, Washington, D.C. 6.41

Karuppur Sari, AD 1800-1900. South India. Made for use in India.

Weavers and dyers had to cooperate to create the patterning on this textile type. During weaving, the gold patterns were created by tapestry methods in a cloth that was otherwise plain-woven. Next, the dyer outlined further patterns on the finished cloth, using a wax resist for lines that would stay white and mordants for lines and zones that would turn black and red. It may have needed only one soaking in the dye vat to produce the full range of black, white, and deep brick red. Notice how carefully integrated the woven and dyed patterns are, and the dyer's use of subtly graded mordants so that the red areas are darker near their edges, to give an illusion of depth. Such cloth was made only in a handful of villages at Karuppur, near Tanjore in southern India. The art of making it has now died out. Cotton and gold. Textile Museum, Washington, D.C. 6.78

Opposite page: Sarong, AD 1700-1800. Southeastern India. Traded to Indonesia.

Another extraordinary cloth, showing superb craftsmanship. Nothing as good is made nowadays in either India or Indonesia. Notice the cleverly hidden birds. An intricate mosaic of geometric forms fills the borders and centerfield of this man's or woman's wraparound skirt. Small, fernlike batik patterns and birds are tucked in the corners, but the primary designs are formed of squares and interlacing knots. The fineness of detail and balance of color shades reveal consummate artistry as well as total mastery of linear design. Made on the Coromandel

the best individual pieces of cloth in existence.

Yet, their beauty and technical perfection may not be the most interesting features of these cloths, for they also stand for a critically important historical phenomenon. In their day, Indian textiles of these types were made and exported in very large quantities. More of them, in fact, were shipped abroad than any other industrial product of premodern times.

True, China had long sent moderate amounts of its silks to places as far away as Rome, while the English as late as the 18th century felt that their most important export was fine woolen cloth. Indeed, the majority of early states seem to have produced at least some textiles for international markets. Woven fiber products made good export commodities, being always welcome to fashion-conscious foreign elites as well as being unbreakable, easy to carry, and valuable in proportion to their weight. The volume of such early textile exports, however, was almost always small. Only in the case of India did the trade involve more than a few hundreds or thousands of expensive cloths per year, destined for wear by a small and wealthy minority.

It is possible that this pattern of "splendid but trifling trade" in luxury items was broken by Indian merchants at a fairly early date. The "Master Dyers" exhibition includes a number of rather coarse, utilitarian-seeming Indian textiles found at the 15th-century site of Fostat, in Egypt. Even earlier fragments of exported Indian cloth have recently been found at Quseir on the Red Sea (see *Bulletin*, June 1980) by Donald Whitcomb, formerly a curator at Field Museum, and Janet Johnson of the Oriental Institute. The Quseir cloths may be as early as AD 1300, and prove beyond question that trade in non-luxury textiles between India and the Middle East existed at that date. However, we have no means of determining the quantities involved. Mediaeval sources have not preserved statistics on Indian textile exports.

The earliest adequate statistics to survive come from the records of the great Dutch and English East India companies, which followed the Portuguese into Asia in the early 1600s and almost immediately found that they had to use Indian textiles to buy spices in Indonesia; the growers were not interested in cash or, seemingly, in most other commodities. The Dutch and English companies both, therefore, became involved in exporting Indian textiles, at first to consumer markets within Asia but soon to consumers in Europe, Africa, and the Americas as well. The two companies are important in economic history as the first of the great multinationals and the first corporations with modern-style stockholders and boards of directors. Fortunately for us, they were also the first commercial organizations to

maintain really good records, and these are what make it possible to reconstruct the 17th-century Indian textile trade in considerable detail.

Briefly, what the records show is a pattern of rapid, almost explosive growth. In 1610, European- and Asian-owned ships were already carrying about ten million yards of cloth to Southeast Asia and the Middle East, plus a few yards of samples to Europe. By 1625, the within-Asia volume had doubled. In the 1650s, the Asian trade had begun to level off at 25-30 million yards, but several million now went to Europe and Africa. A trickle was even reaching the new colonies in North America—one of the first Americans to own an Indian textile was the accused witch, Anne Hibben, who in 1636 was said to have a number of items made of imported calico in her Boston home.

In the late 1660s, European imports passed the ten million mark and continued to rise sharply, reaching a yearly average of between 35 and 40 million by the early 1680s; in the peak year of 1684, the English East India Company alone imported 45 million yards of Indian cloth—more than six yards for each man, woman, and child in Great Britain. If one adds in the exports carried by Dutch and other Europeans and by the then very active native Indian and Arab traders, it seems clear that in 1684 Indian exports to all points totalled more than 100 million yards.

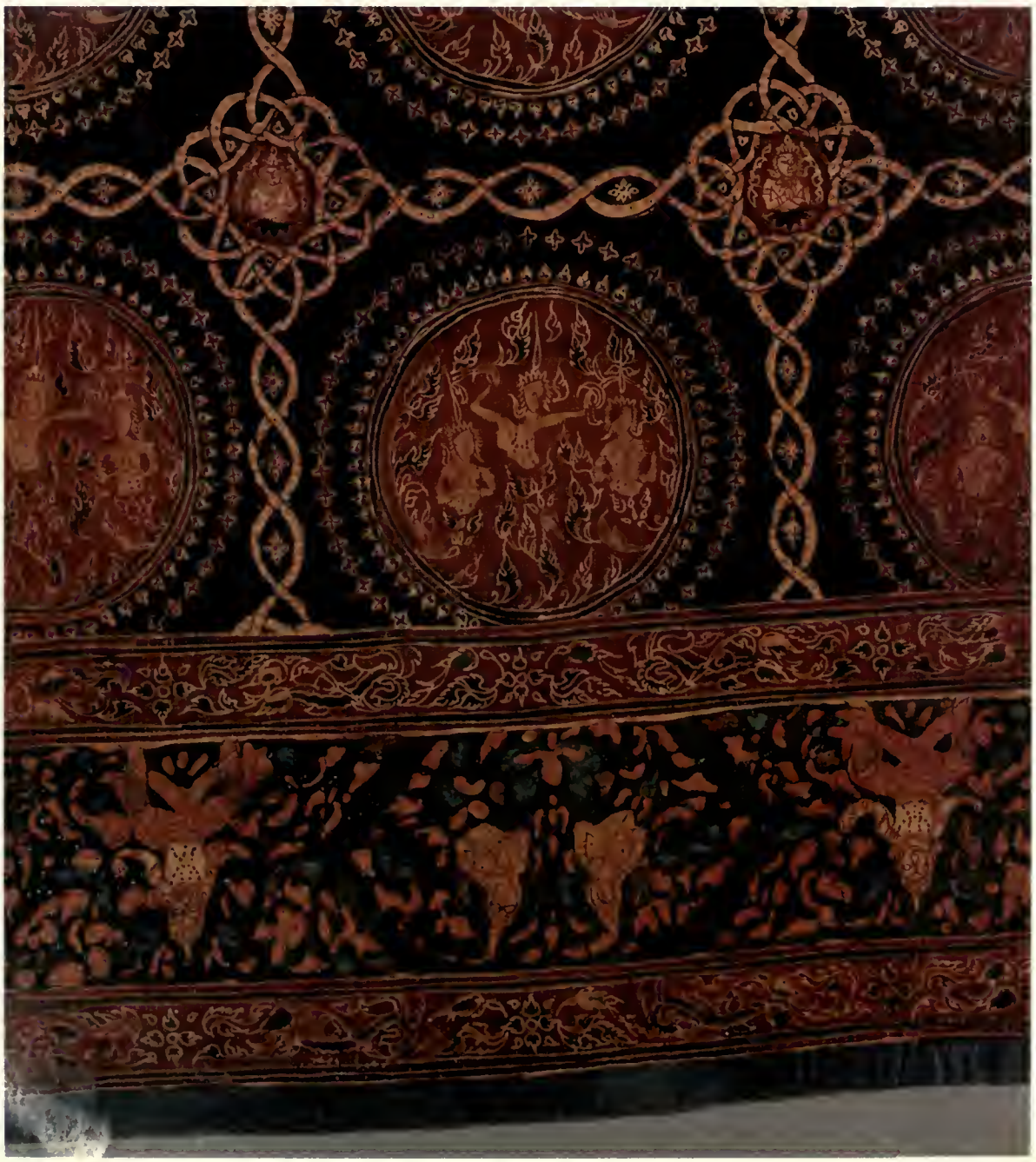
Coast (perhaps in Tanjore), it was collected in Indonesia. Similar cloths were once traded to Thailand and Japan.

Dyed cotton, with drawn resist and brushed-on mordant, Konjaku-Nishimura Collections, Kyoto, Japan.

Given the spectacular nature of Indian export growth and the fact that this was well publicized at the time, it is no surprise to find that the European textile industry was already in an uproar by the late 1670s. By the early 1680s, it was in a panic. Industrialists and lobbyists made impassioned appeals to parliaments and kings. Public relations men and concerned citizens (among them Daniel Defoe, the author of numerous social tracts as well as of *Robinson Crusoe*) produced a flood of pamphlets and newspaper articles claiming, quite plausibly, that hundreds of thousands of European textile workers were about to starve and their national economies irreparably damaged. Unpatriotic wearers of Indian-made cloths were denounced and occasionally assaulted in the streets. Cries for protective legislation were heard in every European capital; some suggested punitive customs duties and others, an outright prohibition against importing or wearing Asian cloth.

Eventually, after considerable opposition from the various East India Companies (of which there were then four, none overly concerned at the whining of a handful of unimportant textile workers and industrialists), the new laws were passed and the Indian threat receded. Much smuggling, of course, continued, and fashion-conscious people of both sexes went on being just as unpatriotic as usual. One Western European nation, Holland, even failed to pass the required legislation. But these sequels do not concern us at the moment.

What matters is the extraordinary situation



Phao kiao (an elephant's cloth?). AD 1700-1800. India. Made for sale in Thailand.

The Thais use diagonal grid patterns and pictures of divine beings in much of their own art. This, however, is Indian work, made according to Thai patterns—yet another example of the first-class market research done by the Indian textile industry.

The three figures in the medallions are kinnari, *a type of divine being also known in India but here depicted in an essentially Thai style. It is evident that the Indian artist had a Thai pattern (a painting?) to copy this part of the design from. The other figures are less Thai in flavor. Perhaps they were drawn by a different person, or perhaps by the same artist working from memory rather than an actual Thai-made pattern. Notice that the mordant for the last stage of dyeing, to produce the brown color, has been carelessly applied.*

The elephant-costume theory is based on one expert's educated guesswork. Though plausible, it is as yet unconfirmed.

Dyed cotton, with drawn and stamped resist and mordants. Victoria and Albert Museum, London T5. 1969.

that existed in the early 1680s when, as seems quite clear, a collection of simple and undernourished brown people in an exotic country managed to pull off an industrial miracle. They had already succeeded in eliminating most of the local textile industry in the Middle East and Southeast Asia. Now they had come within an ace of displacing even the powerful and traditionally successful textile makers of Western Europe. They had in fact done something that had never been done before. For the first time in history, a manufactured non-luxury product made in a single country was on the verge of dominating the consumer markets of the entire world.

The question is, how could this have happened? What was the secret of Indian success? How is it even possible that a collection of impoverished, mostly illiterate weavers and dyers liv-

Indian Textile Terms in English

The India trade of the 17th and 18th centuries brought not only cloths to the West but a new textile vocabulary as well. Much of this vocabulary survives in English, sometimes so well integrated into our language that most of us do not think of them as foreign words.

Bandanna. From Hindi *bandhnu*, a method of tie-dyeing. In the 19th century, a bandanna was a rich yellow or red silk handkerchief with tie-dyed white diamond-shaped spots. In the 17th century, it was a small cloth, perhaps ikat-dyed, from Bengal.

Calico. From Calicut, an important city in southwestern India. Once a pattern-dyed cloth in several colors, the term was later used in the textile industry to mean a grade of fairly fine, plain-woven cotton cloth, often undyed. A memory of the earlier meaning survives in the phrase "calico cat."

Cashmere. From the name of a kingdom, later a province, in northern India and Pakistan. The very fine and soft goat-wool cloth of Kashmir is still highly esteemed, though most cashmeres are woven or knitted elsewhere, often with mixtures of less costly sheep wools. Cashmere shawls, the complexly embroidered cloths from Kashmir that were common here and in Europe in the late 19th century, were not necessarily made of cashmere wool.

Chintz. From Hindi *chint* and Sanskrit *chitra*, "spotted" or "variegated." In the 17th century, a cotton cloth with block-printed or hand drawn patterns. Modern American-made chintzes are glazed printed cloths, often with flower designs, used as curtain and upholstery fabrics.

Dungaree. From Maharastrian *donggari*, a type of plain, coarse, strong cloth, usually white or blue. Dungaree was used for sailors' work clothing as far back as the 17th century.

Gingham. Perhaps from Malay-Javanese *ging-gang*, a name used locally in Southeast Asia and by European traders for a type of Indian cloth. 17th century ginghams were fine striped silk-cotton textiles made in Bengal. All-cotton imitations were later made in Coromandel and, eventually, in Europe and the United States. Some were striped and others checkered.

Gunny. From Sanskrit *goni*, "sack." Since the 16th century, a sturdy but very coarse cloth woven from jute fiber, employed mainly for making sacks in which grain, cotton, and other loose goods were stored and shipped.

Khaki. From Hindi-Urdu *khaki*, "dusty, dust-colored." Various sorts of strong light-brown cloth used for military uniforms. The idea that khaki might have advantages over brightly colored uniform materials does not seem to have occurred to the world's armies until a few British units began wearing it in northern India in the late 1850s.

Muslin. From Mosul, a city in Iraq. The term originally applied to a silk or silk and gold cloth woven in and around Mosul, but traders in India during the 16th century began using it to refer to extremely fine cotton cloths from Bengal. Its modern meaning comes from this Indian usage, though our muslin bedsheets are less delicate than the legendary white muslins of Dacca, said to be so fine that wide pieces could be passed through a woman's ring.

Pajama. From Hindi-Urdu *pae-jama*, "leg clothing." A pair of loose trousers tied around the waist. In European usage, the term came to include a loose shirt as well. Pajamas were popular among Europeans in India long before they migrated to England and the United States in the 19th century.

Percale. Possibly from Tamil *percaula*, "sparkling." Since the 17th century, a plain white cloth made in south India for use as a base in chintz-making. Percales were originally less fine than muslins.

Seersucker. The etymology is unknown but probably related to such vaguely similar 17th-18th century cloth names as *sestienne*, *sukerton*, and *sarasse gobar*. In the 18th century, seersucker was a mixed silk-cotton striped cloth from Bengal.

Taffeta. From Farsi *taften*, "to spin." A fine silk cloth, originally from Bengal in the 17th century. Modern taffetas can be of silk or artificial fibers and are characterized by their lustrous surfaces.

Tussore. Perhaps from Sanskrit *tasara*, "shuttle." A rough silk cloth woven from cocoons of wild silkworms. The term goes back to the 16th century, when it meant an inexpensive type of wild silk from eastern India.

ing in backward villages in remote parts of Asia could compete on a more than level footing with the long-famous textile industries of western Europe? In what conceivable way could they do this when their product had to be shipped twelve thousand expensive miles—around the southern end of Africa—before it could be sold in competition with European cloths made with the most modern machinery only a few miles from the marketplace?

Spokesmen for the hard-pressed European industry had several answers. They hinted at a plot by the giant (and indeed, ruthless) East Asia companies to monopolize the textile business by selling at a loss so as to bankrupt all competitors. They decried the irrationality of feminine fashion, which chose frivolous Indian stuffs over honest English (or French, Dutch, etc.) broadcloth. And they complained constantly at the unfairness of having to compete with the extremely low-cost labor of India.

All of these assertions were undoubtedly in a sense correct. Yet, as might be expected, the cloth makers of Europe did tend to view the situation in a rather one-sided way.

The vast power of the East India companies, for instance, was clearly a factor but hardly a decisive one. At the time, the companies had little real control within India. The weavers and dyers were not their employees, and neither were the wealthy middlemen with whom they contracted each year for delivery of given amounts of cloth; the companies' factors often had to buy their supplies on the open market just like anyone else. They were not even the biggest buyers in that market.

Native Indian merchants owned ships as large as the Europeans and regularly carried more cloth and other goods to some of the major foreign markets (to the Middle East, for instance). Further, the companies faced what a modern corporation would regard as an intolerable amount of overhead: arbitrary taxes and bribes exacted by officials in both Europe and Asia; the two-year period needed for their ships to make one round trip, eating up interest and maintenance costs all the while; constant losses from shipwreck and piracy; the need for fortifying all trading stations and hiring private armies and navies to protect these; and—on top of everything—the startling dishonesty of their own employees in an age when bribes and kickbacks were normal practice but conspiring against one's employers was considered bad form everywhere except, apparently, among Europeans stationed in Asia.

Thus, although the companies seemed to make astronomical profits from the textile trade, their margins were in reality quite thin. What kept the cloth they sold competitive was good accounting and good market research based on careful tracking of sales and constant experimentation with new patterns and fabrics. It could well be argued that the European textile industry's main problem was bad management. They might have had much less trouble in fighting off the Indian challenge if they had been nearly as good at the marketing side of their own business as were the East Asia companies.

The idea that consumers were buying Indian instead of French or British cloth simply from frivolity was of course just wishful thinking. As far as one can judge from the few samples that survive, the Indian cloth was actually better: at least as beautiful, more practical, and a good deal cheaper than anything comparable on the market.

The beauty is evident. The designers in India, about whom little else is known, seem to have worked much like their modern counterparts, staying in close touch with producers and buyers, creating patterns targeted at the specific needs of certain markets, and actively experimenting with new weaves and patterns which might expand a market or create one where none had existed before. Surviving cargo manifests show that it was a rare shipment in the 17th century that did not include special bundles of samples or "new-style stuffs," apparently aimed at testing and rechecking consumer tastes. The two Europe-bound cloths illustrated on pages 12 and 13 are of types that were as nontraditional to Indians as to Europeans; the patterns of both probably originated as special samples created in the early 1700s, a period when tastemakers in Europe were particularly interested in novel designs.

Further, both the old and the new designs for export cloths tended to be well executed by the Indian weavers and dyers, who seem to have been capable of handling an unusually broad range of techniques and of changing these rapidly in response to shifts in demand. One of the difficulties of studying 17th- and 18th-century Indian textiles is guessing where they came from, when one knows that hundreds of clothmaking villages in several different parts of India were quite capable, if necessary, of adapting to the production of almost any type of cloth.

We might note in passing that the high quality of Indian designs is proved not just by the few cloths that have survived but by the reactions of European manufacturers, who may have denounced the frivolous imports in public but who were apparently in private making every effort to imitate them. They continued doing this for more than two hundred years. As late as the 1830s, when the Indian economic challenge had

been crushed by colonial armies and by the Industrial Revolution, the bulk of the colored cloths produced by the power looms of Manchester in England and Lowell in Massachusetts were still called by Indian names such as ginghams, chintzes, and calicoes and were printed with flower designs nearly identical with those shipped from India to Europe two hundred years before. In fact, 17th-century-styled chintz is still being made. It can be seen, used for sofa covers and curtains, in almost any furniture store.

a cheap labor supply. European clothmakers tried such explanations but were no more convincing than a modern American manufacturer would be if he tried to attribute the success of Japanese television sets to the same factors. Modern Japan, as we have all become aware, makes good electronic equipment because it has technology as good as or better than its foreign competitors. The same conclusion appears to apply to the comparison of 17th-century Indian and European textile industries. India was not at all back-

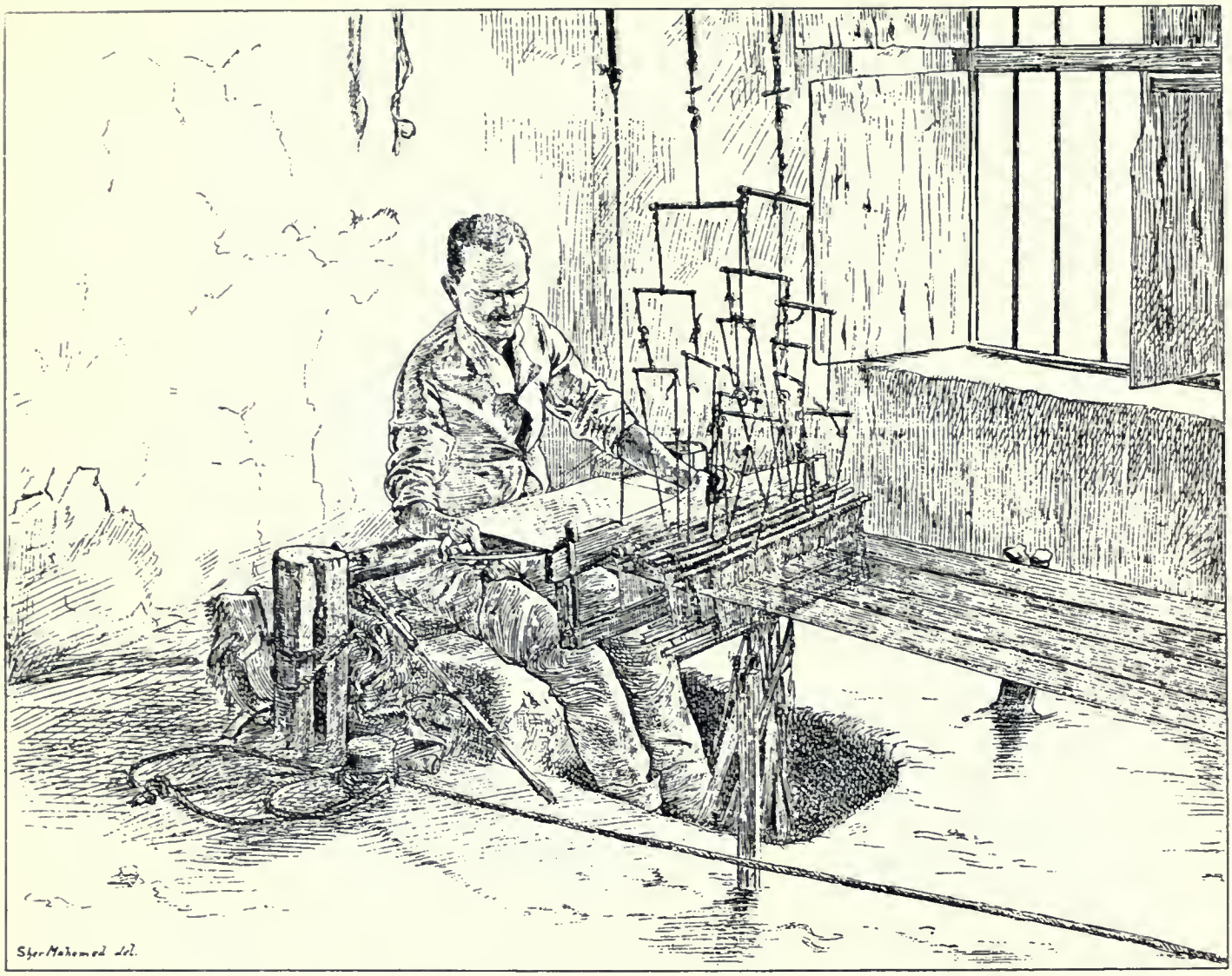
The "calico craze" in Europe. *Importing (and, in France, wearing) Indian patterned cloth became illegal almost as soon as, in the 1680s, it became fashionable. Among the few Europeans to risk having portraits made while dressed "a l'Indienne" are this French nobleman in 1695, in a morning gown (of Bengali silk-cotton?), and this presumably non-noble Frenchwoman in 1790, modeling a dress of Indian cotton in the style and colors of the French Revolution. The original prints are in the Bibliotheque National, Paris (left), and one of the British national collections in London (right).*

On the other hand, good styling and able marketing were not the only things, and perhaps not the main things, that sold a product back in that remote pre-advertising age. Consumers then were at least as impressed by practical qualities as by esthetics and image, and this was where the superiority of Indian cloths was perhaps most evident. They came in colors which could be washed repeatedly without fading. Being mainly of cotton and cotton-silk mixtures, they were far more comfortable for wear in warm weather and indoors than were the traditional woolens and linens of Europe. And, of course, they were economical. Many were outstandingly cheap, and even the most expensive types were more durable and better made than any non-Indian cloth that could be sold at a comparable price.

The important point here is that differences in practical qualities like these cannot be explained simply in terms of marketing ability and

ward. In fact, incredible as it may have seemed to their competitors and in spite of the apparent simplicity of their looms and other equipment, Indian clothmakers were in many ways far ahead of Europe in scientific understanding of their trade.

This is perhaps most obvious with respect to the Indian knowledge of dyes. The key to giving permanent colors to plant fibers like cotton and linen is the proper use of mordants—compounds of iron or aluminum which intensify and fix dye colors by causing them to "bite" into the surface of the fiber. India had a whole range of these as well as dyes that were better to begin with. They also employed their mordants in complex ways, typically using two different mordants at once and then blocking off other areas of the cloth surface with a "batik" wax resist, making it possible to produce several colors with a single immersion in the dye vat. An important Indian innovation was the use of special pens



An Indian silk-weaver. This craftsman, from Thana near Bombay, weaves on a draw-loom built into the earthen floor of a house. In spite of its rustic appearance, it is a sophisticated machine capable of producing complexly patterned cloth. From Journal of Indian Art, *5, 1886.*

and several kinds of wood and wood-and-metal printing blocks to apply both mordants and resists, making the process much faster and, if desired, enabling the dyer to produce patterns of astonishing complexity.

Contemporary Europeans seem often to have thought that India had discovered a mysterious method of painting or printing dyes directly onto the cloth, but dyers there had no more luck with this approach than anyone else in the days before modern chemical dyes. What the Indians painted or printed on were only the colorless mordants and resists; they achieved their actual colors through soaking cloths in conventional dye vats. The general idea was by no means a commercial secret. Yet European dyers had much trouble with it, even when using imported Indian dyestuffs. Few of their colors could withstand washing, especially when the cloth involved was of linen or cotton and often too when it was of wool or silk. It seems to have taken more than a century and a half of experimentation before Europeans learned how to make the full range of dye colors truly permanent on plant fiber cloths; not until the 1750s does one begin to find British dyers claiming that their own chintzes were just as good as the authentic Indian product.

One of the more interesting sidelights of this particular issue is its connection with sanitation. Europeans had worn colored linen cloth for thousands of years before they came in contact with Indian dyeing technology. The question is, how did they wash these? The answer seems to be, as rarely as possible. Some unmordanted colors are not safely washable even on easily-dyed woolen cloths, and almost none are fast on linens and cottons. Early wearers of Indian imports tended to exclaim that the colors actually became brighter after washing. As in the case of similar statements about Oriental rugs, naturally this was an exaggeration. But it was also a bit ominous if one thinks of what it implied about all the people who were wearing non-Indian colored cloth. We have little definite data on the atmosphere of public places in Europe between the Neolithic (when flax and cotton were first domesticated) and the late 17th century, as the

noses of even the acutest social critics tended to be desensitized. However, it is tempting to think that the new Indian dyeing technology had an effect on public health that was at least as significant as its role in fashion.

Other technological advances by Indians were more important in keeping prices low than in improving the quality of the product. Methods of applying designs by using blocks rather than brushes had been perfected in India long before the first European contacts. In spite of the difficulties of preparing whole sets of finely carved and precisely matched blocks—as many as five or six sometimes had to be fitted inside one other, each for a separate color—the block-stamping technique was a clear improvement in terms of the speed with which cloth could be decorated. Low-priced textiles for sale within India and on the African and European markets were generally produced in this way.

Much of this market was of great interest to European textile manufacturers, who saw enormous potential in sales to slave traders, Caribbean plantation owners, American Indians, and poor people in their own countries. Yet here again imitating the methods used in India proved quite difficult. Intensive research and experimentation in cloth "printing" (on imported Indian white cloth—European cloths were apparently not smooth and even enough) began in England as early as 1650. It was not fully successful until about 1750, and continued to be done with Indian-style flat wooden blocks for another quarter-century before the introduction of the faster and almost equally precise copper-cylinder rotary printer.

Another advantage of the Indian textile industry was its access to large supplies of cotton, a plant which grows well in Indian soils and which, as the most high-yielding of major fiber crops, is intrinsically the least expensive material for making cloth. Europeans also sometimes cited this as one of the reasons why Indian competition was unfair. Yet, using Indian-style cotton also required technological know-how which contemporary Europeans had still not developed.

Spinners and weavers in Britain during the 17th century are said to have had trouble even with the long-stapled (and comparatively unproductive) Sea Island cottons of the Caribbean, and it took many years before they could handle the high-yielding short-fibered cottons which India had always used. Their success in learning how to gin and spin such cottons was in fact a key element not only in the Industrial Revolution of the 1770s through the 1790s but in the tremendous growth of cotton plantations in the American South.

One could probably find still more explanations for the earlier industrial success of India: an outstandingly flexible financial system, organizational methods that involved a much greater rationalization of production than in Europe (where weavers as late as the 1700s often still spun their own yarns, dyed their own cloth, and even made it up into tailored clothes), and entrepreneurial attitudes among the merchant classes which were at least as strongly developed as any such attitudes in Europe. However, I will not get into such topics here. It is enough to emphasize once again the extraordinary fact that India in the 17th century came very close to controlling most of the world's textile markets, and that the explanation was by no means as simple as their embattled competitors claimed.

A story that has been hinted at but cannot be fully told here is that of the long-range European response to the Indian challenge, for this would involve nothing less than describing the origins of the Industrial Revolution. One wonders whether anyone alive in the 1680s could have imagined such an outcome. Assuming that such a person was aware of the now widely recognized role of textile industries as keys to industrial development (in most nations, clothmaking has been the first industry to be mechanized, and profits and know-how from that have tended to be the mainspring of growth in other economic sectors), would he have had any idea of what was actually going to happen?

Would it not have been most logical to predict that free trade would eventually triumph, that the superbly efficient textile makers of India, in tandem with the heavily capitalized East India companies, would eventually overwhelm their European competitors, and that Indian capitalists would then mechanize their mills and move onward to the improvement of their (already highly regarded) iron and steel industry?

It is in fact one of the more tantalizing and least recognized might-have-beens of history. If things had worked out only slightly differently, the Industrial Revolution might have taken place in India. We could now be living in a world where Indian tourists complained constantly about the squalor of England and where Europe and North America would be underdeveloped quasi-colonies whose main function was providing raw materials for the insatiable factories of Bengal and Gujarat.

Among the reasons why this did not happen were the high quality of 18th- and 19th-century European armies (which eventually seized the main Indian textile-producing centers and thus found a noneconomic solution to the problem of unfair competition) and the surprisingly open attitude of European textile manufacturers. As pointed out earlier, these manufacturers had

been thoroughly frightened back in the 1670s and 1680s and so had lobbied hard for stringent controls on Indian imports. When they got the tariff protection they wanted, however, they seem not to have succumbed to the normal tendency to relax into old and inefficient ways. Instead, they initiated a major, long-term program of research and development.

They made intensive studies of Indian weaving, cloth-printing, and dyeing methods. Slowly and then with increasing speed they began to learn. By 1760 they could imitate all except the very finest of Indian cloths. By 1785, after two decades of remarkable innovation, they had made most of the key inventions of the Industrial Revolution and were in a position to sell good cotton cloth even more cheaply than the Indians. By 1790, the clothmakers of Britain had become apostles of free trade, denouncing all tariffs as obstacles to economic progress. By 1800, Indian textile exports to Europe had fallen almost to zero and were dropping sharply in Africa and North America.

The final symbolic victory of the Europeans did not occur until 1830. In that year, or possibly in 1831, in the early summer of the Industrial Age when Britannia already ruled the waves and most of India as well, the mills of Manchester shipped forty million yards of cotton cloth to India. They thus matched for the first time the quantity of cloth that had been exported in the reverse direction, from India to Britain, almost a hundred and fifty years before. □

CREDITS

Thanks are due to Dr. Mattiebelle Gittinger and other members of the staff of the Textile Museum of Washington, D.C., the originating institution for the "Master Dyers to the World." The Textile Museum has gone beyond normal professional courtesy in helping with the Field Museum version of that exhibition. Further, it has allowed not just its photographs but its printer's actual color separations to be used as illustrations in this article.

Dr. Gittinger conceived the exhibition, went through the arduous loan negotiations connected with it, and wrote the remarkable catalogue listed in the bibliography below. This looks as well on a coffee table as any exhibition catalogue. However, it is also a ground-breaking work of historical and artistic scholarship. Most of the captions for the color plates in this article are partially borrowed from it. So are some of the ideas, although Dr. Gittinger naturally is not responsible for the present author's mistakes.

Bibliographic Note

While most of the data given here can be checked in readily accessible sources, a few conclusions are based on economic statistics culled from the *Daghregisters*, the voluminous daily records kept at the Dutch East India Company's headquarters in Batavia. These data will eventually be published in full, but interested readers are invited to contact the author if they find anything in this article that seems to contradict the standard works listed below.

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Irwin, John and Katherine B. Brett

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RESERVES *con't from p. 10*
mined because the capital investment was mostly made long ago, when the ore was richer.

The point of giving this long example is to explain another common misuse of so-called "facts" about ores (and oil) by politicians, bureaucrats, some members of industry, and the news media. If they want to scare you with a "fact" they can say, truthfully, that the So-And-So Mine, which used to mine 4 percent copper ore has been squeezed down to lean ore of only 0.02 percent—a sign that America is running out of copper!

This need not necessarily be true. Certainly, based on this particular mine alone, it can't be correctly concluded we're running out of copper. The old mine continues to operate because it's cheaper to mine lower grade ore at a site where all the capital facilities already exist than it is to start up a new mine, even where the ore might be a little bit richer.

I do not think that those who use such examples incorrectly (and I heard this specific example used years ago) are necessarily aware of the complexities that make their points invalid.

Thus, depending on what kind of reserve you're talking about, it's possible to make any kind of case you like. I've heard different "leading authorities" quoted in the press, making statements such as "America has more coal reserves than any nation in the world," and "America's coal reserves are outstripped by those of China and the Soviet Union." Both "authorities" can actually be correct, even though their statements contradict one another. It depends on whether they're lumping together measured + indicated + inferred reserves, or are talking about only measured reserves. On top of that, depending on the point the speaker wants to make, he might use only measured reserves for the USA and measured + indicated + inferred reserves for China, or vice versa. Once again, games can be played with loose usage of the word "reserve."

Another word, mentioned earlier, is *resource*. Although many use it interchangeably with *reserve*, it doesn't mean the same thing at all. A mineral resource is the total amount of a given mineral in the earth's crust under a given region. It includes all the three kinds of reserves plus all amounts of the substance that are present at trace levels of concentration, regardless of the cost or technical means to extract it. The total resource is generally a number that is unknowable with high accuracy. It only can be estimated.

It happens, often, that public figures and the news media use estimates of resources to make a point, but treat them as if they were reserves. Thus, the earlier example of the 50 percent of oil that is still in the ground in the USA is actually a resource. Under present technology it is too costly to extract to be a reserve. The remaining oil resource may someday become a reserve. It is, however, possible to conceive of a hypothetical resource that would never become a reserve. For example, if there existed a two-inch-thick layer of coal at a depth of 8,000 feet under the entire United States, the total tonnage of coal would be 632 billion tons! This would be an enormous resource, but absolutely unexploitable. The energy required to mine such a thin layer at such a depth over such an enormous area would far exceed the energy that could be ever obtained from burning the coal. Such a resource would never, under any technology or price structure become a reserve.

Those individuals in the public eye, who make statements about "vast untapped resources (or reserves)" are often armed with dubious figures and erroneous concepts of this kind. Some of these policymakers are totally unaware of the basis for the figures they use. They have the idea that if economic factors are right, anything can be extracted. In some cases this is true; in other cases it can never be true.

Finally, for those resources and reserves that are geographically restricted there are serious economic considerations. Ores, such as copper, zinc, and lead, occur in many places in the world. They are resources for many different countries and those countries which do not have much of them have a choice of countries from whom they can purchase these minerals at the best price. On the other hand, some ores are very restricted. The best example of this is chromium, which occurs in abundance in Rhodesia, South Africa, and the USSR. No other country has any significant chromium. Yet it is chromium, when added to steel, that makes stainless steel, which is used in a large number of industries, particularly in the sanitary handling of foods. Milk, for example, can only be transported hygienically in stainless steel tanker trucks. Although the United States may take strong exception to the politics of some of these countries, it must deal with them to obtain chromium ore.

Ever since the first cave man picked up the first stone to use as a tool or weapon, mankind has used the mineral materials of the earth for his well-being. Back then, the mineral wealth appeared limitless. Today, with better knowledge of mineral resources, it still appears almost limitless. True, some materials are in limited abundance in the long pull—like oil and certain metals. Substitutions will have to be made, and have been made already in some cases. In the long run the main resource that we will need is the ingenuity of mankind. So far, that seems to be truly limitless. □

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February 1983

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COVER

Two sculptures by Henry Hering (1874-1949), a New York sculptor who had been a pupil of the famed Augustus Saint-Gaudens (1848-1907). These two figures, twice life-size, represent "Science" (left) and "The Dissemination of Knowledge," and may be seen near the northwest and northeast corners, respectively, of Stanley Field Hall at the second-floor level. (Corresponding figures representing "Record" and "Research" are at the other two corners.)

The four pieces, executed about 1917, were among a total of 14 statues, 4 bas-relief figures, and a lion-head medallion done by Hering for the new Museum. Eight of the figures, for reasons now unknown, were never incorporated into the architecture of Field Museum. Four, however, found their way above the north and south porticos of Chicago's Museum of Science and Industry. These figures represent the four directions. The location of the remaining four statues, representing the four traditional elements—air, water, fire, and earth—is unknown.

The Field Museum statuary as well as the rest of the building's imposing architecture may be studied with particular advantage during special two-hour guided architectural walks that are being jointly sponsored by the Field Museum and the Chicago Architecture Foundation.

These walking tours will be held at 1:00 p.m. on the following Sundays: February 6 and 20, March 6 and 20, April 3 and 17. Cost of the tour is $5.00 for members (Field Museum or Chicago Architecture Foundation) and $8.00 for nonmembers. Reservations must be made with Betsy Kittle at the Chicago Architecture Foundation, 782-1776. As the tours are limited to 25 persons, please call early to reserve your place. We are sure that even the most seasoned traveler will find these walks a delight!

Special Events

"Natural History Film Festival"
Saturdays at 1:30pm, West Entrance
February 5, 12, 19, and 26

Many of the most engaging and beautiful natural history films in the world are the work of a group located in the city of Bristol, England who specialize in wildlife programs for the BBC television. Rich in visual content and meticulously researched, the Natural History Unit's films illustrate animal behavior, botany, ecological issues, and other biological topics. Join us at Field Museum February 5, at 1:30pm as Chris Parsons, currently head of the BBC Natural History Unit, introduces six weeks of exciting film. These films are made possible through Films Incorporated, exclusive distributor of BBC films in the United States. The films are free with Museum admission. Tickets are not necessary.

February 5	Chris Parsons, Introduction "Animal Olympians," (50m) "Water Walkers," (25m)
February 12	"The Rotten World About Us," (50m) "The Impossible Bird," (25m)
February 19	"Tree of Thorns," (50m) "The Impossible Bird," (25m)
February 26	"Invasion of the Land," (58m) "Ambush at Masai Mara," (25m)

Highlights

Africa: A Celebration of Black Heritage

"Dances of West Africa," with Najwa Dance Corps
Sunday, February 20, 3:00pm, Stanley Field Hall

In an exciting mixture of dance, music, drama, and history Najwa Dance Corps brings to you a performance which preserves the styles and techniques of different eras in African history. Najwa I is an internationally acclaimed dancer who has continued a tradition of teaching, performing and artistic endeavors through the Najwa Dance Corps. The Corps performs a suite of dances in celebration of "Daso."

The performance is free with Museum admission. Tickets are not required. This program is partially supported by a grant from the Illinois Arts Council.

"Africa Alive" Family Feature
Saturday and Sunday, February 26 and 27
1:00pm, Hall E

Africa is a continent of many cultures and distinctive art styles. A walk through Hall E, Cultures of Africa and Madagascar, introduces you to the creativity of these diverse people.

"Ashanti Gold Weights" In West Africa, brass weights were used by the Ashanti to measure gold dust. Using clay, make your own small weight in geometric, animal, or human shapes.

"Jewelry of Masai" The Masai people of East Africa are famous for their beaded necklaces of multicolored strands. Find out why jewelry is important and make your own Masai necklace.

"The Art of Tie-Dye" Join artist Rah-Bird as he demonstrates the rich African tradition of textile tie-dyeing. Watch beautiful patterns emerge on cloth and learn how the decoration of fabric has become a truly creative art form throughout Africa. →

Field Museum Events

Weekend Programs

Each Saturday and Sunday you are invited to explore the world of natural history at Field Museum. Free discovery tours, demonstrations, and films related to ongoing exhibits at the Museum are designed for families and adults. Check the Weekend "Passport" upon arrival for the complete schedule and program locations. These programs are partially supported by a grant from the Illinois Arts Council.

February 6	1:00pm	Kwakiutl Winter Ceremonies, tour
February 12	11:30am	Ancient Egypt, tour
February 19	1:00pm	Tibet Today, slide lecture/ tour
	2:00pm	Film Feature: "Salmon People" (25m) and "Potlatch: A Strict Law Bids Us Dance" (53m)
February 20	2:00pm	Film Feature: "Haida Carver" (13m) and "Nathan Jackson, Tlingit Artist" (14m)
	3:00pm	Treasures from the Totem Forest, tour
February 26	12:30pm	Treasures from the Totem Forest, tour
	1:00pm	Tibet Today, slide lecture/ tour
	2:00pm	Film Feature: "The Legend of the Magic Knives" (11m) and "The Crooked Beak of Heaven" (55m)
February 27	2:00pm	Film Feature: "In the Land of the War Canoes" (45m)

Coming Events

"MUSIC FROM THE BAMBOO FOREST"

with Douglas Ewart and Inventions
Sunday, March 6, 3:00pm, James Simpson Theatre
Members: $3.00, Nonmembers: $5.00

Experience the delightful, lyrical music of Douglas Ewart and Hamid Hank Drake on winds and percussion along with special guest performers. Watch for more program information in the March *Bulletin*.

MUSEUM HOURS: 9:00am to 5:00pm daily
MUSEUM TELEPHONE: (312)922-9410

COURSES FOR ADULTS

Begin the week of February 7. Call 322-8855 if you have any questions about the courses offered.

WEEKEND EVENTS LINE: (312) 322-8854

Take advantage of our Weekend Events Line for up-to-date information about special events, weekend programs, and Family Features. The recorded message gives detailed information about the Department of Education's special programs.

Registration

Please complete this coupon for your program selection and any other special events. Be sure to complete all requested information on the ticket application and include the section number where appropriate. If your ticket request is received less than one week before a program, tickets will be held in your name at the West Entrance box office until one-half hour before the event. Please make checks payable to Field Museum. Tickets will be mailed upon receipt of check. Refunds will be made only if the program is sold out.

Program Title	Member Tickets # Requested	Nonmember Tickets # Requested	Total Tickets Requested	Amount Enclosed
			Total:	

Name

Address

City State Zip

Telephone Daytime Evening

For Office Use

Date Rec'd **Date Returned**

Return complete ticket application with a self-addressed stamped envelope to:

Public Programs: Department of Education
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, Il 60605-2497

Have you enclosed your self-addressed stamped envelope?

AFRICA

A Celebration Of Black Heritage

Sunday, Feb. 20, 3:00pm
"Dances of West Africa," with Najwa Dance Corps, in Stanley Field Hall.
This program is free, with Museum admission; No ticket required.

Saturday, Feb. 26, 1:00pm and
Sunday, Feb. 27, 1:00pm
February Family Features: "Africa Alive" in Hall E. These features include three new participatory activities: "Ashanti Gold Weights," "Jewelry of Masai," and "The Art of Tie-Die."

Sunday, March 6, 3:00pm
"Music from the Bamboo Forest," with Douglas Ewart and Inventions, in Simpson Theatre.
Members: $3.00; nonmembers: $5.00

These programs are partially supported by a grant from the Illinois Arts Council.

"Music from the Bamboo Forest," with Douglas Ewart and Inventions

Najwa Dance Corps

DID YOU KNOW. . .
7 OUT OF 10 PERSONS
HAVE NO WILL?. . .

Your will opens up so many opportunities:

- You can decide on distribution of your assets; (without a will the state does it for you)
- You can resolve important responsibilities, such as naming guardians for minor children; (without a will, the state decides for you)
- You can save unnecessary costs and estate taxes, in many cases;
- Make special gifts to special friends;
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But too many people put off writing their wills, until it's too late. Call your attorney today and make an appointment to draw up your will right away!

And remember that Field Museum of Natural History welcomes bequests as a thoughtful means of support. Your bequest goes into the Endowment Fund, income from which supports exhibition, education, and basic scientific research programs. Your name and your bequest to Field Museum thereby become as perpetual as natural history itself.

Our free booklet helps get you started. . . Write for it today!

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Please send me my free copy of "37 Things People 'know' About Wills That Aren't Really So."

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City _____ *State* ___ *Zip* ___

You can reach me at:

Phone (home) _____

(business) _____

FIELD BRIEFS

Master Dyers to the World: Early Fabrics from India Now on View in Hall 27

The stunning new show, which opened January 29, will continue through April 10. It is an international loan exhibition organized by the Textile Museum in Washington, D.C. in conjunction with the U.S. Subcommission of Education and Culture and with the official cooperation of the Indian Government. The exhibition features the superb pattern-dyed cloths made in India between the 15th and 18th centuries and highlights the achievement of Indian textile artists in colorful patterning of cotton textiles with brilliant fast dyes.

Cecilia Bodman, B.V.M. 1905-1982

Sister Cecilia Bodman, a long-time volunteer in the Department of Botany, died on December 14. Her area of special interest was the Tremallales, a complex group of fungi, and her expertise was used to particular advantage in curating this part of the Museum's plant collection.

A member of the Sisters of Charity of the Blessed Virgin Mary, Sister Cecilia was professor emeritus of biology at Mundelein College, where she had served as chairman of the Biology Department.

Attention Chocolate Lovers

Field Museum Stores now carries edible elephants—in the form of dark chocolate "coins" embossed with the image of the fighting bull elephants in Stanley Field Hall. Wrapped in gold foil, they come handsomely packaged—two to a box. If you've never set a tooth to an elephant, now's the time. Eighty-five cents a box.

Volunteers Honored

Field Museum's army of faithful volunteers will be honored on Friday, February 14, with a cocktail reception in Stanley Field Hall. Special recognition will be made of those who volunteered 500 hours of service or more during 1982 and of those who have served 15 years or more. In a coordinated program headed by Joyce Matuszewich, volunteers serve the Museum in virtually every phase of its special activities: specimen preparation, collection maintenance, library work, public education programs, cataloging, editing, scientific drawing, and a great deal more. Their collective contribution of skills, expertise, and energy is of critical importance to Field Museum.

Gifts and Bequests for 1982

Thanks to the support of its many friends, Field Museum was able to balance its operating budget for 1982. Unrestricted contributions for the year amounted to $1,738,376; restricted gifts and bequests totaled $1,551,601. The total private support was $3,289,977. The Museum is most grateful to those who have thus helped sustain day-to-day operations as well as its vitally important programs of research, exhibition, and public education.

A Reunion, of Sorts

Among Field Museum's better known collections are the bronzes of sculptress Malvina Hoffman (1887-1966), known as The Races of Mankind. Totaling 104 pieces, they were commissioned by Field Museum in 1930. In 1933, when 80 percent of the pieces had been completed, they were placed on view in Hall 3, where they remained until 1967.

Many of the Hoffman pieces are still on view in the Museum, but they are no longer together in a single location. One of these, *Kashmiri Man*, in Hall N, was the reason for a recent visit by Mr. A.N.D. Haksar, of India. The handsome figure, in a pose of meditation, was modeled by the visitor's father, Prakash Haksar, half a century ago. A.N.D. Haksar posed for the Museum photographer with the image of his father, and the result may be seen in the photo below. In 1971, Prakash Haksar's daughter, Mrs. Kiran Dar (above) also visited for the same reason. The photo at left is of Prakash Haksar at about the time he modeled for the statue.

The Journal of Wilfred Osgood

The Marshall Field Chilean Expedition of 1922-23

Introduction by Bruce D. Patterson
Assistant Curator of Mammals

Wilfred Hudson Osgood (1875-1947), one of the most distinguished curators ever to serve on the Field Museum staff, first came to the Museum as assistant curator of mammals and birds in 1909, after serving as assistant biologist in the Biological Survey of the U.S. Department of Agriculture. In 1921 he was made chief curator of zoology, a post he held until retiring in 1941; he remained active afterwards as curator emeritus. During the course of his remarkable career he produced 205 papers and books.

Osgood made many contributions to systematic mammalogy (the study of evolutionary relationships among mammals); perhaps the greatest of these was an understanding of populations. Unlike other taxonomists of his day, who routinely named individual variants as subspecies, species, or even genera, Osgood recognized the natural variation within populations as an integral aspect of systematics, something to be understood in terms of environmental conditions and history, and as the raw material for natural selection. His approach to nomenclature is well documented in his first two generic revisions, that of the pocket mice (*Perognathus*) published in 1900, and of the deer mice (*Peromyscus*), published in 1909. Osgood examined some 3,000 specimens in the course of the former work, and some 27,000 specimens during the latter. In doing so he erected a standard still current in systematic mammalogy. It should come as no surprise that subsequent revisions of these genera have found little to improve upon.

Like other great systematists, Osgood based his studies on extensive fieldwork. During his career, he made 30 expeditions of varying durations that carried him to the far corners of the globe. Fieldwork gave Osgood a first-hand knowledge of his material that could never have been achieved through the study of museum specimens alone. The journals of his expeditions, comprising 26 volumes in the Museum's library, contain a great wealth of natural history information as well as his impressions of peoples and places now remote in both space and time.

While preparing for my own fieldwork in the Chilean archipelago, which began last month (January), I consulted Osgood's account of his trip there as leader of the Marshall Field Chilean Expedition of 1922-23. Osgood began fieldwork on Isla Chiloe, a large island some 600 miles south of Valparaiso, the biota of which had last been studied by Charles Darwin during his *Beagle* voyage. Darwin's collections on the islands in 1834 had been the basis for many scientific names, and Osgood wished to investigate this biota more fully. Accompanied by Colin C. Sanborn and Boardman Conover* of Field Museum, and by Luis Moreira of Chile's National Museum in Santiago, Osgood spent six weeks on Chiloe, assembling the first North American collection of Chilean mammals. The specimens he collected there would later prove to contain a

Northeastern shoreline of Chiloe Island, Chile, where Osgood collected in 1922 and 1923.

genus, a species, and three subspecies of mammals that were new to science.

The following is Wilfred Osgood's account of that trip, as recorded in his journal:

Dec. 21. Left early this morning [from Quelen on the island of Chiloe] and arrived in Quellon [near the southern end] around noon. Established ourselves with Ruperto Vera who supplied us with a vacant house and gives us meals at his own table — not too good, but substantial. Tripe, sheepsheads, kidneys, pigsfeet and other tidbits from a larger part of the menu than we would prefer. Got a few traps out before dark in some swampy places on cleared ground and in a bit of woodland. Saw a snipe and a number of small birds. Shot a fine *Hylactes*, my first Tapaculo, called here wit wit or whet whet on account of its loud much repeated call which is startling when it proceeds suddenly from a thicket only a few feet away. Found some small mottled toads under logs on a hillside.

Dec. 22. Caught some small mice which look like *Akodons*. They are fairly common and seem to prefer cleared land altho they live also in *el monte*. Sanborn got a yg. house rat and they are common along the beach.

Dec. 31. A little over a week in Quellon gives us some idea of the fauna of Chiloe. Birds are very abundant but the number of species seen so far is only about 30 exclusive of waterbirds. The very common ones are the robin or *zorzal*, the *diuca* [finch], chincol [rufous-collared sparrow], house wren, two tapaculos, a small *Scytalopus* [babbler], a small white crowned greenish flycatcher (*Elaenia*), a hummer, and a *Phrysilus*. A fine *Cinclodes* is abundant on the shore which is mostly flat and gravelly or pebbly. It flits about the front street and lights on the fences, docks, etc. At low tide it is pecking around under the pilings of the docks and buildings. It also appears along streams in open meadows and there acts much like a water thrush and its appearance also suggests that bird. Chimangos are fairly common and often seen beach combing but they are distinctly less numerous than farther north. A flock of black-headed gulls and some pintail ducks stay around a grassy salt flat. Several Hudsonian curlews work around the bay. Large black-headed gulls are also seen. A couple small white terns are about and perhaps are Arctic terns or some similar species. A few penguins appear

Wilfred Osgood during his 1922-23 expedition, or shortly thereafter.

now and then often near shore and one day a boy brought in a live one tied with a string to its foot. Two or three small porpoises amble along our waterfront nearly every day. A large white-bellied and white-necked cormorant is in small numbers and a few black ones also. According to indefinite reports, pelicans have been known to occur. Foxes seem to be practically unknown in this part of the island and many people here say there are none anywhere on the island, but some know of reports of them on the west coast. Near San Pedro Id., where Darwin got the type of [*Dusicyon*] *fulvipes*, none have been seen within any reliable memory. Deer are common apparently as soon as one gets away from clearings and cultivation. The only other mammals mentioned by the natives are the coypu [an aquatic rodent superficially resembling muskrats] and the otters. They hunt these in the summer season when the fur is poor and of little value because they say it is easier to get them than in the winter when the fur would be of more value. For coypu skins they get about 5 or 6 pesos or less than $1 each.

The land is pretty well cleared near the shore and is pasture with stumps, patches of ferns, and small swampy areas given to sphagnum-like moss and bunches of *Juncus*. The forest behind is not like a northern forest, but reminds of a tropical forest or more especially of the temperate forest of the Andes although it is less luxuriant than this. It is full of climbing bamboo which is usually very difficult to get through. There are some air plants and much moss on the large

*Colin Sanborn (1897-1962) was a preparator in ornithology at the time of this expedition; when he retired in 1956 he was curator of Mammals. Boardman Conover (1892-1950) was never a Museum staff member, but in 1936 he was made a research associate in Birds and from 1940 until his death he served on the Board of Trustees.

trunks. A little red flower that looks like a waxy fuchsia is abundant on mossy trunks and stubs everywhere.

Conover and Moreira arrived on the 29th and established themselves with us in the old house. Began negotiations to get away. . . .

Jan. 6. Weather right and fine and less wind but the expected steamers do not come and our patience is running low. This afternoon a boy brought a large cocoi heron and Sanborn tackled the job of skinning it. The *Huandad* came in and we engaged her to take us to Inio for 250 pesos, not expensive for five men, a big rowboat, and 31 pieces of baggage, not counting guns, etc. Had dinner on shore and went aboard about 10 o'clock after trying again to swat the one or two small bats that fly up and down the street. The *Huandad* was filthy, crowded and uncomfortable, but we got the special privilege of sleeping or trying to alongside the cap's cabin.

The coypu, a rodent common to Chiloe Island that superficially resembles the muskrat.

The Huandad *tied up at Quellon, Chiloe island. The "filthy, crowded, and uncomfortable" ship took Osgood and his companions on an overnight trip to Inio.*

Jan. 7. Made a good camp in a grove of large trees after clearing away much "quila" or bamboo. Fresh water from a spring. Big salt marshes around the mouth of the river. As we came in saw many gulls, cormorants, black oystercatchers, etc. Spent most of the day making camp.

Jan. 8. Weather fine, bright and cloudless. Traps near beach yielded only common *Akodon*. There is a sort of yucca like plant, perhaps a screw pine, growing in the rocky points about the beach and other plants not seen elsewhere. Crossed the river and worked around grassy slews but couldn't get far on account of tidal channels. Conover and Sanborn went up the beautiful long curving beach and Luis picked a good mess of wild strawberries, round and rather hard, not quite so well flavored and juicy as ours, but still very good indeed. In afternoon found trail across to another beach east of us showing we are on a peninsula which forms the eastern boundary of the *estero* [estuary] of the Inio. The country is very flat but some low hills can be seen up the river. Huapiquilan and various small islands are easily seen. The vegetation behind all the beaches having a south frontage is much influenced by wind and has a picturesque look. Found some fox tracks on beach. . . .

Jan. 9. Again clear and bright . . . . found a cat that at first glimpse didn't look unlike a domestic pussy. . . . Later in day. . . a fox . . . was brought in by fishermen whose dog smelled it out.

Jan. 10. Warm and fine. Went down to end of east beach and on around several points of rock. Wonderful shell beaches, some of them good sized shells still unbroken—pure shell and almost nothing else. Saw a couple deer tracks near a little water hole. There is very little fresh water here and our camp supply is limited and

none too good. Caught a large eared *Phyllotis* and Sanborn got several and some *Oryzomys* around the old fishing shack across the river. Shot a large-eared bat, perhaps an *Eptesicus* [in fact, a *Histiotis*].

Jan. 11. A few thin clouds this afternoon, but fine weather. Sanborn found a stranded porpoise on the beach this morning and we took its skull and some of the meat since it was still warm and seemed to have been killed by being pounded in the surf in shallow water. Saw a penguin at close range fishing and driving little fish out of the water in front of him.They are very seal like in action and even have a sort of sniffing snort as they come up after a long dive. They are not abundant here and are usually seen singly.

Jan. 12. A little foggy this morning but bright later in the day . . . . Conover took an all day hike up the beach and got some steamer ducks, kelp geese, and oystercatchers. Hudsonian curlews by hundreds.

Jan. 13. Quite cloudy till late in afternoon when the sun appeared. Quite pleased to find a *Caenolestes* in one of my mouse traps this morning. Evidently it ran across the trap as it was caught by one hind leg only. It is small and has a short much thickened tail. Its color is plain brown much like *obscurus* . . . Its premolars are very peculiar and doubtless it is generically distinct from the northern forms. A little misty rain this evening and light west wind. Quite calm for last three days.

Jan. 14. Set more traps last night in *Caenolestes* territory but had a poor catch. The one specimen was caught in a dry runway under a log at edge of bamboo thicket. There is much bamboo or "quila" here and all dead or dying after fruiting which it is said to do every seven or eight years.

Jan. 15. Last night put [out] fresh fish bait . . . in the east beach and was rewarded this morning with a nice male fox in fairly good pelage. This makes a pair from a locality only 15 to 20 miles from the region where Darwin got the type [of *D. fulvipes*] and settles the point as to whether the animal still occurs there. Several people in Quellon seemed to doubt its existence, perhaps because of an inclination to discredit Darwin if possible. Mouse traps in the woods which I baited with bacon and meat failed to get more *Caenolestes*, but caught a couple of the short-tailed shrew mice . . . [*Notiomys valdivianus*] showing their preference for that kind of bait. Found a couple Darwin's frogs in a mossy place in deep woods after a rain.

Boardman Conover, who assisted on the expedition, was a generous donor to Field Museum until his death in 1950.

Continued on p. 28

Quellon residents. Note penguin on tether.

TOURS FOR MEMBERS

M E. Rada

Grand Canyon Adventure

May 27 - June 5
$1,600

An exciting 280-mile cruise down the Colorado River by motorized rubber raft, camping outdoors under the stars. Dr. Bertram G. Woodland, curator of petrology, will lead the tour. Group limited to 25. For additional information call (322-8862) or write the Tours Office.

The following account of Field Museum's 1981 Grand Canyon trip was written by participant Gail Richardson:

I grew up in the city and never considered roughing it. When the letter came from the Field Museum announcing a white-water rafting trip down the Colorado River through the Grand Canyon I was horrified to hear my husband of 21 years gleefully announce, "We're going, of course!"

"Rapids? Sleeping *outside*?" I croaked. "Never!"

Two months later on a blazing mid-July day I stood on the beach at Lees Ferry, Arizona, surveying with dismay the two 37-foot rubber rafts which were to transport our group to Lake Mead on the down side of some of the roughest rapids in the world. Our leader, a charming geologist from the Field Museum, made me almost ashamed of my terror since he was making the trip with a broken collarbone and cracked ribs received in a mugging six days before. Seeing his bravery I decided I could at least *pretend* to enjoy myself for the next nine days. To my amazement pretending wasn't necessary. I had the adventure of my life and became a convert to camping.

I discovered the skyscraper doesn't exist that can rival the Canyon spires, slashed with hotly glowing colors. No luxury hotel anywhere can provide a suite as glorious as the Canyon at night. Lying on the top of my sleepingbag with no bugs to pester me I watched the stars arrange themselves across the inky sky in their ageless constellations. I hadn't known they could sparkle so brilliantly.

I, who had dreaded the rapids, joined those who rode in front, yelping in delight as we catapulted into foaming torrents and roaring with laughter when we got drenched in 55 degree water. You dried in ten minutes, anyhow! Quickly, I forgot to wonder what my hair looked like and chuckled with the others about our bedraggled state.

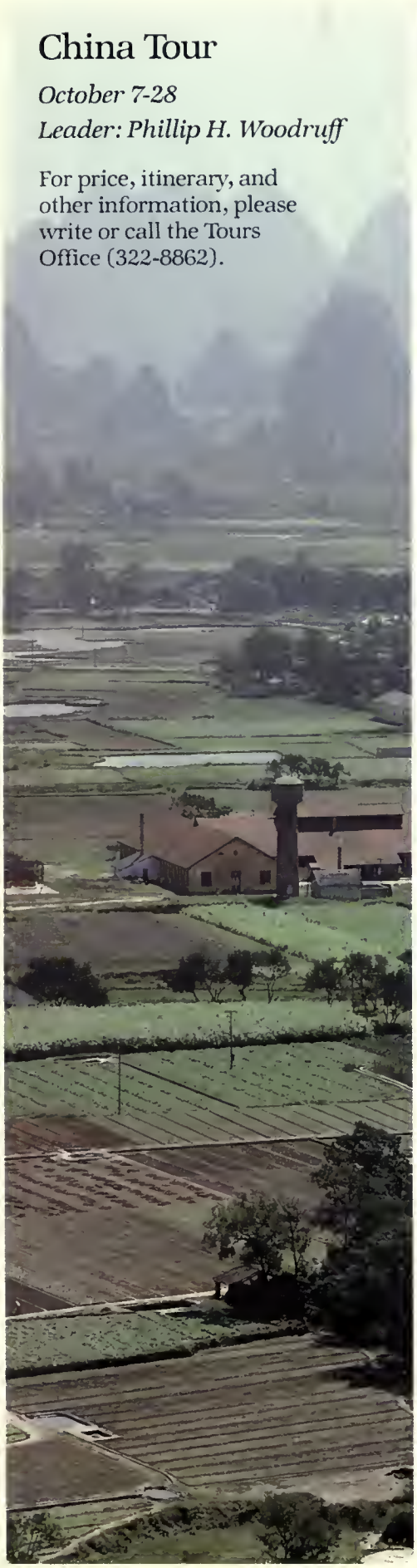
No opulent spa or resort pool can stand comparison to the springs and natural pools tucked within the inner Canyon. Where water exists the desert retreats, and we were enchanted to find ferns and plants in profusion surrounding a cascade or feathering the outlines of breathtakingly clear, sun-warmed water where we frolicked and dove and knew we had come close to paradise.

China Tour

October 7-28

Leader: Phillip H. Woodruff

For price, itinerary, and other information, please write or call the Tours Office (322-8862).



Photos by Stanton R. Cook, courtesy *Chicago Tribune*

The 400-year-old church of Ixmiquilpan, in the state of Hidalgo, Mexico, is a treasury of murals that incorporate Precolumbian American as well as European traditions.

Opposite: *The beautifully tiled aisle flanked by rows of narrow, wooden pews leads to an altar dominated by an elaborately structured shrine. Portions of murals are at right.*

Precolumbian Murals in a Mexican Church

by Terry Stocker *and* Barbara Jackson

Photos courtesy of the authors

Ixmiquilpan is a quiet town one hundred miles north of Mexico City in the arid state of Hidalgo. With 10,000 inhabitants, it is a population center of the Otomi Indians. During Precolumbian times, the Otomi were regarded by the Aztecs as a fierce and warlike people, and one of the highest echelons of Aztec warriors was called the Otomic class. Today, the Otomi continue to survive, using ancient crafts such as beating fiber from the agave cactus and weaving this into carrying bags, which they sell.

It is possible that the sixteenth-century Spanish *conquistadores* were aware of the Otomi's reputation as a savage and violent people when building the fortresslike church that dominates one side of the Ixmiquilpan town plaza. The massive walls of the colonial church are supported by flying buttresses, and entry is through a set of heavy wooden doors with five hand-wrought hinges on each side. The Spanish friars may have felt that they could be safe from an uprising behind the stout walls and doors.

Inside the church, murals painted about 1564 by the Indians as part of their corvée, or work service required by the conquerors, were a constant reminder of potential violence. The

Portion of mural in alcove.

The muraled walls of the dimly lit sacristy hold an important clue to the meaning of the painted allegory lining the walls of the chancel and nave.

four-hundred-year-old Augustinian church and attached monastery of Ixmiquilpan are little known for these murals that depict Indian warfare, decapitations, and other brutalities. They were, in fact, hidden from view for almost 300 years by coats of paint applied over them. They were not revealed again until the early 1960s, when the clergy and congregation decided to renovate the church. When parts of the walls were stripped of old layers of paint, the murals were exposed. News of the unique archaeological discovery soon spread throughout Mexico and the world. Although the murals were executed in the style of Aztec picture paintings, a combination of European and Aztec elements makes those murals unlike any other known.

Except for the murals, the church interior is like that of any other large colonial Mexican church. However, the murals bring to light a strange chapter in the history of Christianity. Each of the unique painted images can be considered as pages in a text of New World history. The story begins on the wall to the left of the entrance, proceeds to the walls of the chancel (behind the altar), continues on the right wall, and ends to the right of the entrance. Five dis-

Two Indians engage in mortal combat. The one at left wears the peaked headdress symbolic of the converted chief. Above him arches a heavy vine, presumably a symbol of guardianship. The vine motif occurs elsewhere in the murals, always associated with the Christian warrior. At left is a severed head, below a fallen warrior.

tinct panels are on each of the side walls. The walls of the chancel are decorated with the idol of an Aztec image on the days of various saints.

The significance of these murals has continued to perplex anthropologists, historians, and church scholars. We, too, have been perplexed since we first viewed the Ixmiquilpan murals in 1972. But in July of last year, while on a trip to Ixmiquilpan to photograph the murals, a chance event gave us the opportunity to grasp the elusive meaning of the murals.

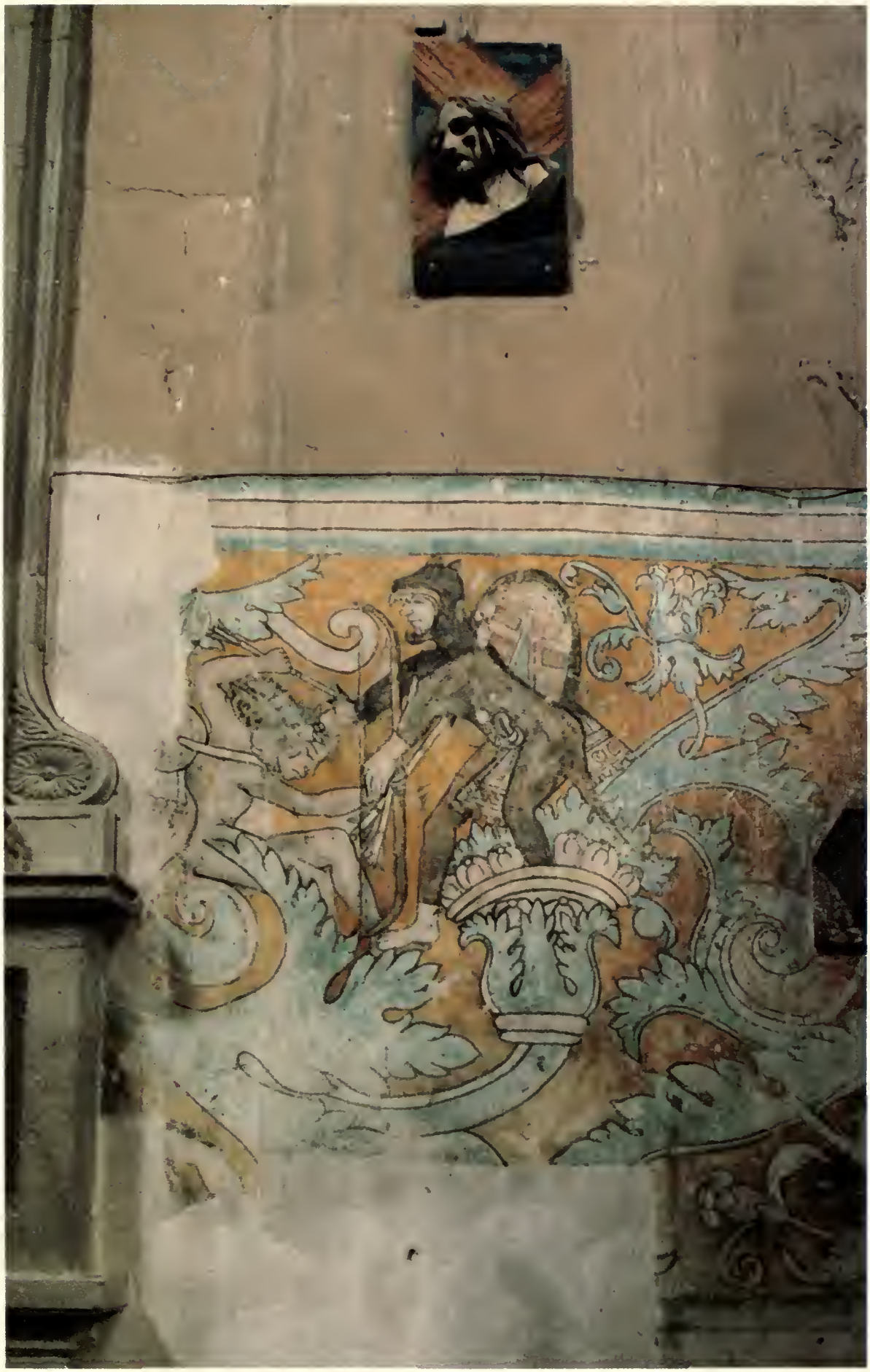
On that occasion we were accompanied to the Ixmiquilpan church by photographer and fellow Mexico traveler, Scott Lamb. As Scott viewed the murals through his camera, a young woman came up to tell us that the mayor's permission was necessary before photographing the church's interior. At the mayor's office, across the town square, we were referred to the local priest. The same young woman then returned with us to the church where we could telephone the priest from a back room.

To our astonishment, we found that this room's walls were also covered with murals, as was the adjacent sacristy. All but one of the scenes were of stages in the life of Christ; the exception portrayed the conversion of a local Indian chief to Christianity in front of the newly arrived padre. The murals in the sacristy were all of a European style, while those in the nave and chancel were a stylistic combination of European and Aztec elements.

The headpiece of the Indian chief depicted in the sacristy attracted our attention, for most of the victorious Indian warriors shown in the church's murals wore a similar headpiece. The similarity suggested that the major theme of the murals was a military confrontation between newly converted Indians and those who had denied Christianity.

Among Precolumbian Indian groups military victory was determined by one god prevailing over another. The murals' jaguar—the major diety or symbol of Precolumbian warfare—is depicted with an arrow through its body, thus symbolizing the victory of the Christian god over the god of the Ixmiquilpan Indians. The scene of the Jaguar's death, presumably, is the conclusion of the painted allegory.

The victorious warrior shown below the



Below a bust of the crucified Christ, the mural shows a warrior dressed in traditional warfare garb of a coyote costume.

The final chapter of the allegory is in two sections. The upper section represents the defeat of the heathen Indian nation by Christianity. The piercing of the jaguar's body with an arrow symbolizes the death of the non-Christian Indian civilization. The lower section (compare with that shown on p. 18) shows actual combat. The presumed victor, wearing the peaked headdress and brandishing an obsidian-lined sword, has decapitated one opponent, wounded another, and is engaging a third.

slain jaguar wears a headpiece identical to that worn by the converted chief represented in the sacristy. The portrayed warrior, in fact, may be the converted chief engaged in battle against the "heathens." The shield he carries, on which a human head is painted, is unlike any other in the Ixmiquilpan murals; Precolumbian shields, as a matter of fact, have never been found with human representations. The face on this shield is probably a beardless representation of Jesus Christ, who is the ideological victor in the battle. The Aztecs, themselves, had a bearded god named Quetzalcoatl in their mythology, though he was seldom depicted with a beard.

Once the end of the mural allegory was identified, the beginning became apparent on the opposite wall at the entrance of the church. The initial scene is a painting of the symbol of the Aztec nation, an eagle perched on a cactus holding a serpent in its beak.

The second scene is fragmented, but it appears to be a representation of a victorious warrior wearing a jaguar skin. The diagnostic headpiece of the converted chief is lacking, however. This scene can be interpreted to mean that the Christian converts were initially attacked by the non-Christian Indian groups. The remaining panels are scenes of additional battles. Often they are too fragmentary for description or interpretation. Even where complete, their significance is not always apparent.

A question for future archaeological research will be whether murals of similar warfare scenes occur in other colonial churches. This is doubtful. Ixmiquilpan is probably unique in this respect because the militant force of the area, though small, was fierce enough to defeat even the Aztecs. Thus, the principal message of the murals was that the Christian god vanquished the pagan gods. The conversion of the remaining non-Christian Indians probably took another hundred years to be accomplished. After that, a more conventional set of murals was probably painted over the originals. The walls were painted a third time before the present century.

The decision of several years ago to paint the Ixmiquilpan church for a fourth time and the subsequent, startling revelations, left the congregation and the church with a curious paradox: the walls are a national archaeological treasure, but their meaning has remained unknown to those who pray by them.□

Detail of combat

Plants That Lie And Cheat (well, almost)

Caralluma speciosa, *a succulent asclepiad of Africa, produces large foul-smelling flowers which attract flies.*

By William Burger
Chairman, Department of Botany
Photos by the author

Plants are a rather static form of life; many spend their entire existence rooted in a single spot. Though they can create dramatic flourishes with new foliage or colorful flowering, we generally do not think of plants as having much in the way of behavior. It is therefore surprising to come across words such as fraud and deceit in the botanical literature.

References to deception in the life of plants are mostly associated with the process of flowering. Large and colorful flowers are large and colorful in order to attract pollinating insects or birds. (Many plants have been bred to be even larger and more colorful to decorate our homes and gardens.) Colorful flowers attract pollinators to enhance cross-pollination (cross-fertilization). The benefit of cross-pollination for the plant is a generation of seeds with a greater variety of traits. This seems to be a kind of insurance policy. If conditions change, a more variable array of offspring should have a better chance of including a few individuals suited to the new conditions.

But what are the advantages of cross-pollination to the pollinating insect or bird? None, directly; the pollinators must be rewarded for their visit. These rewards usually come in the form of energy-rich food for the pollinators: nectar or pollen. The colorful flower-parts are just the advertising; pollen or nectar is what the flower-visitor is after. The bumblebee must gather sufficient food and energy not only to keep itself going, but also to feed its brood, ensuring that there will be bumblebees in the year to come.

It is in this special relationship of flowering plant and pollinating animal that some species of plants have taken to cheating. That is to say, a colorful show but no nectar. While rare, this type of flowering behavior has been reported both in little orchids and in a few large tropical trees. The trees in question, members of the catalpa family, can be quite spectacular. First, they drop all their leaves; then they put out a synchronous show of brilliantly colored and large flowers. A few days later the flowers are gone and, hopefully, enough bees and other insects have been fooled so that pollen has been carried from tree to tree in sufficient quantity to produce an adequate seed crop.

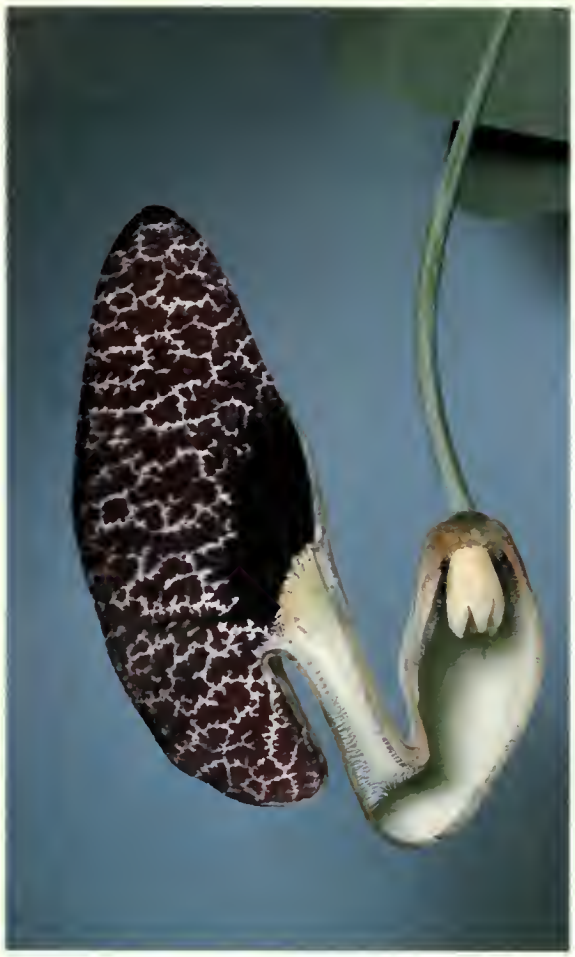
Cheats, whether in the plant world or our own, cannot be too obvious or too common. Whether a large tree or a little orchid, the cheating strategy is generally the same: mimicry, or looking like an "honest" plant. In the case of the trees just mentioned, they are not common and they resemble other trees of the same family which also lose all their leaves and also put on a colorful synchronous show of flowers.

Grass pink orchid flowers in the foreground appear to be mimicking the phlox flowers in the background.

Our native orchid, the grass pink (*Calopogon pulchellus*) often lives in sites close to the smooth phlox (*Phlox glaberrima*) and flowers at the same time. While the flowers of grass pink and phlox differ greatly in form, they are similar in size and very similar in color. The grass pink appears to mimic a model (phlox) which is both common and a reliable source of nectar. Grass pinks are far less common than phlox and offer no nectar, but the system works because the mimicking orchids are not encountered as often as nectar-bearing flowers of phlox. A recent study of a similar orchid, *Calypso bulbosa*, has shown that the flowers bloom at a time in early spring when newly emerged queen bumblebees are making their initial flights. Thus, there are many "naive" bees out seeking nectar when these nectarless fakers (the calypso orchids) are in full flower. But the bumblebees don't stay dumb, and soon learn to recognize the nectarless orchids.

A few orchids have carried the art of deceit even further down the road of sin and degradation. These particular species take advantage of two weaknesses in their insect dupes, poor eyesight and masculine impulsiveness. These insects—male bees or flies and lacking any sense of restraint—have the unfortunate habit of pouncing on the objects of their desire. The orchid flowers, mimicking the female insects, get pounced upon with sufficient frequency to effect cross-pollination. During the insect-orchid encounter, the pollen sacs of the flower are pasted onto the body of the insect in such a way that the pollen sacs can be transferred to the flower of a later mistaken encounter. In a recent publication an especially macho bee is illustrated carrying 32 pollen sacs on his rump, evidence that he had recently embraced no fewer than 16 orchid flowers.

From a discussion of pleasures of the flesh we can readily shift to a more common form of floral deception, rotting flesh. A small percentage of flowers augment a color scheme of dark reddish purple with aromas that range from mildly offensive to strongly putrid. Such flowers attract flies whose larvae develop in decaying animals. Some of these flowers do more than simply attract the flies; they trap them for awhile. The entrapment ensures that the flies will be covered with pollen when they are re-



Left: *Cutaway view of the flower of* Aristolochia elegans. *Color and odor induce flies to enter the tubular part of the flower. There, they may be trapped for a day as the flower shifts from its receptive phase to its pollinating phase.*

Right: *A large* Amorphophallus *inflorescence. An odor of rotting flesh attracts flies down into the purple spathe. Minute flowers are borne on the lower part of the central spadix.*

leased. This combination of entrapment and mimicry of rotten flesh is found in certain flowers of the aroid, asclepiad, and aristolochia families.

Other forms of deceit in the plant world are much less dramatic. Such deceptions are often part of the plant's defense system. Some desert succulents look so much like their rocky surroundings that they seem to have camouflaged themselves. The "flowering stones" of southern Africa have been interpreted as the products of such a defensive strategy. They are easy to see only when they produce their showy little flowers.

One of the most interesting cases of defensive deception regards leaves with little white rounded protuberances on their upper surfaces: fake insect eggs! The resemblance of these leaf developments to the eggs of certain butterflies in a few species of plants is no accident. This form of plant deception requires that the butterflies inspect the plant before they lay their own eggs and that they tend to pass by plants that appear to have had eggs already deposited on them. This is a smart operation on the part of the lady butterfly; if eggs are already on the plant, the first-hatched caterpillars may devour the smaller caterpillars of a later brood. Recent experiments have shown that by removing the plant's "fake eggs" the butterflies are in fact more likely to deposit eggs.

Biologists are not content to exclaim "isn't nature wonderful"; part of the business of biology is trying to explain how these marvels have come about. The general explanation is natural selection. In the above case, plants with little white spots may have had fewer caterpillars chewing on them and been able to produce more seeds. If the little white spots were part of the plant's hereditary make-up, one can see how this trait would increase in time under the continued "pressure" of the butterflies and their caterpillars.

Mimicry, whether by plants or animals, has been a central topic in discussions of natural selection. However, some scientists have been troubled by the use of 'natural selection' as a retroactive explanation for almost everything we find in nature. Nevertheless, there is recent evidence that the evolution of plant mimicry in response to selective forces goes on unabated. The most recent examples are where modern agriculture has introduced new environmental parameters and the plants (mostly weeds) have responded. In a few cases some weeds have developed seeds very similar in size and in weight to the seed crop with which they grow. The

selective factor here is the mechanical seed-harvesting machinery. The weed seeds, by "mimicking" the seed crop, get themselves harvested and distributed, and are thus more likely to be part of next year's crop.

It matters little whether one approaches these natural phenomena with the analytic mind of a scientist or the delight of the child. What is fascinating is that as we continue to study nature we continue to discover novel and intricate relationships. Many of these discoveries are being made in the tropics, both because the tropical biota has been poorly explored and because it is so rich in diversity. And that brings up an unfortunate note. While millions are being spent to study the interior of the atom and the far reaches of space, far less is being spent on the study of tropical biology. Stars and atoms will be here for eons, but much of the tropical biota is fast disappearing. □

*Parts of this flower of a South American orchid (*Trichoceros sp.*) resemble the body of an insect. This species is probably pollinated by male insects as described in the text.*

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AYER FILM LECTURES

March and April

JAMES SIMPSON THEATRE

Saturdays, 1:30 pm

The entrance to James Simpson Theatre is conveniently located inside the West Entrance. This is of special interest to the handicapped, for the entrance is at ground level, with all steps eliminated. The West Entrance also provides free admission to the theatre. Access to other Museum areas, however, requires the regular admission fee (except on Thursdays) or membership identification. The film/lectures are 90 minutes long, and are recommended for adults. Doors open at 12:45pm.

March 5
"Mexico" by Robin Williams
Follow the coastline of Mexico from the Sea of Cortez to the Caribbean. Our journey begins at Loreto, first capital of the Californias and continues on to the land of the Maya—Uxmal, Chichen Itzá, Muna, Izarnal, and Cancún.

March 12
"Europe by Train" by André de la Varre
Take a ride on the world's fastest train, *Tres Grand Vitesse*, which reaches speeds up to 200 mph. Tracking through Europe, tour a czar's train, witness a Croatian wedding, attend a Yugoslavian wrestling match, and see how lace is made in Antwerp.

March 19
"Belgium" by Kathleen Dusek
Belgium is a land of two peoples—the Dutch-speaking people of the north and the French speakers of the south. Visit a lace-making school in Bruge, St. Bavo Cathedral at Ghent, and Antwerp's diamond industry center. To the south explore Waterloo, St. Jacque's Church at Liège, and Belgium's hub of activity: Brussels.

March 26
"California Wilderness" by Bob Roney
Within California's boundaries are the highest point in the western hemisphere, the Sierra Nevada, deserts, redwood forests, the Pacific coast and lush valleys. Discover the variety of plant and animal life that populates this rich landscape.

April 2
"Hawaii" by Frank Nichols
A visit to 4 of Hawaii's most beautiful islands where we see the orchid gardens of Nani Mau, King Kamehameha's birthplace, watch a Filipino community celebrate its 75th anniversary in Hawaii, and a Buddhist dance festival. The finale is a ride through Kauai's central mountains.

April 9
"Vancouver" by Tom Sterling
Sterling takes us to the rainforests and beaches of the Northwest Coast. On Vancouver Island we spend time with elk, deer, wolf, and a rare marmot. Traveling to Victoria, British Columbia's capitol, we meet orca whales, watch tufted puffins, peregrine falcons, and Steller's sea lions.

April 16
"The Naturalist Afield" by Steve Maslowski
Beginning in fall with a trip to Yellowstone and Teton National Parks, we witness the jousting of bull elk, the drilling for sap by the sweets-loving sapsucker, and the denning of foxes.

April 23
"The Three Rivieras" by Frank Carney
Travel to the Italian Riviera with its villages of the Cinque Terre and Michelangelo's marble quarries. The French Riviera offers a contrast between ultra-modern cities and quaint villages. We continue on to the Spanish Riviera, the Costa Brava.

April 30
"Mighty Mississippi" by Willlis Butler
Follow the Mississippi for almost 2,500 miles, from its source in Minnesota to the Gulf of Mexico. The color, sights, sounds, history, and music are presented to you as we travel back in history and into the future of this mighty waterway.

Continued from p. 11

Town of Castro, Chiloe Island, visited by Osgood. Note distinctive diagonal planking of center structure.

Jan. 16. A party of five Chilotes came in today bringing another live Pudu which their dogs had put into the water on their way down from Quellon. This seems to be the common way of hunting the deer — in fact, the only one, although it might be possible to jump them in a region where they were abundant. We have seen only a few tracks on the beaches and it is evident that they are not common here. Bought the deer for another 20 pesos and tied it in camp. It seemed to have been scarcely hurt by the dogs and tugged actively at its rope, usually going to the end of its tether and then trying to break away by making a leap which resulted in its going around in a circle with its back bowed up and its head jerked down at every jump. It showed no combativeness, but after becoming somewhat exhausted it lay down and sulked. . . .

Jan. 17. Sanborn and I set out with the tide this morning to go up the Rio Inio with the boat, this being our last chance. It began to rain shortly after we started and we had rather a wet trip. Passing the sand bars and shallows of the "estero" we came in about 2 miles to a river more or less confined between banks heavily forested. The tide helped us along and we went up some 8 or 10 miles, rowing for about 4 hours. The lower river is about 50 to 100 ft. wide and runs thru heavy forest. Some narrow grassy "pajonales" continue up a couple of miles from time to time and thereafter the banks were difficult to land on on account of the over hanging vegetation. Many trees and bushes seem to grow in the brackish water and some 4 miles up there were frequent places where the boat had to be pushed and eased thru branches. All along there was much "quila." Finally came to a place which seemed to require much work with the ax and as it was still raining decided to make camp. Managed to find a place where we could land the boat and cut away enough "quila" to pitch the little fly we carried. Managed to get a fire started and while Sanborn took a nap I prospected around and ran into a little pool of fresh water which was something encouraging for we had only a little pailful and hadn't seen any side streams, the ground all being rather low and the banks obscured with vegetation. After supper sat on our cots under the fly in a drizzling rain and cleaned our guns and watched the tide go down and darkness come in. Trees and what seemed to be bushes came out of water and stood stark and muddy in the dusk. A coypu came swimming by when nearly dark and a hurried shot failed to get him because in reaching into a handful of shells lying in the cot, I picked the only load of 20.5 buckshot in the lot.

Jan. 18. Rained very hard almost all night and this morning our little 20 ft. sq. clearing was surrounded by dripping bamboos etc. and the river was flowing bankful with a strong current, against which it was clear we could do nothing with our heavy boat and clumsy hand made oars. The tide was due to fall but the river continued to run at the same level and it was evident the waters had increased from the rain to such an extent that the tide from below would have no effect on them. The river water was found to be perfectly fresh. Our plan of going up and downstream in the tide, therefore, seemed hopeless and after an hour or two getting breakfast and fooling around, decided to move downstream and make another camp altho the prospects of getting more wetting and clearing out more quila had no charms for us. The clouds lifted a little and we started, Sanborn in the bow and myself in the stern paddling quietly with one of the short oars. A couple miles down, an otter, the so-called Huillin was seen swimming near the bank and as we swung around it dove and came up near the boat lifting its head clear of the water giving Sanborn a fine shot and a load of sixes killed it. It floated on the water a moment as we turned the boat and then with a big splash disappeared and we thought we had lost it, but it soon came floating down about 6 in. below the

surface and might have been missed if it had not passed close by my end of the boat within reach of my hand.

Went on down and cleared considerable brush out of the river, expecting to come back in the evening. In the wet and rush Sanborn threw his machete along with a piece of brush into the river. Cut our way into the bank and made another camp. Firewood still harder to find and rain continuing in little showers. Cleared a little and at 5 o'clock started downstream looking for otters and coypu. Signs of otter are abundant and at half tide the dark caverns among the roots of the trees along the bank show where they run. In two hours floating and paddling we saw three coypu swimming in midstream several hundred yards in front of us. Altho there was little light and no noise, each of these saw us and dove at a distance to come up with a tail slap under the bank near us as much as to say goodbye. Returning upstream, used the carbide lamp and jacked carefully all the way but failed to see anything. Reached camp about 11 o'clock somewhat disgusted. Sanborn took a couple shots at a big cocoi heron thinking it was a deer and we heard some large owls. Saw a small bat, smaller than the one we have taken [probably *Myotis chiloensis*].

Jan. 19. Up at 3 this morning to catch the ebb tide but even at that we were late and had to pull against the beginning flood before reaching the main camp. The forest along the banks of the river is very beautiful and in many places suggested a stream in Wisconsin or Michigan. Saw a night heron, a small bittern, a pair of kingfishers, and many robins. The robins were along the muddy banks at the water's edge and at a little distance appeared like shorebirds. On the salt marsh around the *estero* coming up saw a flock of white-rumped swallows congregated as if for migration. Saw more curlews, yellowlegs, oyster-catchers, etc. Reached camp around noon in good weather and found it a busy place. Conover had been to Huapiquilan yesterday where he got many Carrancas and half grown young. The deer had died yesterday, apparently of starvation and Conover had bought a couple coypus from the native hunters. They also had a *Gato del Mar* [small sea otter, literally "sea cat"], but wanted 50 pesos for it which he refused to pay. Later 4 Chilotes from Rio Zorra appeared and I bought a couple more coypus from them. In the afternoon, another bunch appeared and somewhat to our surprise announced that they were the ones commissioned to take us back to Quellon. We were too busy to do much for them but they pitched a camp on the shore near us.

Jan. 20. Took in all my traps which had been standing while we were away in the chance of something worth while. Many rotten mice and one fine male *Caenolestes* far gone and full of fly blows. It is essentially the same as the female but much larger. The tail is bluish black and much thickened. The terminal ⅖ of the underside is white and the upper side of the same is speckled blackish and white, the tip being white all around. The feet are dusky with the toes abruptly white, especially in the front feet. The nasal plate seems rather long and has a well-marked longitudinal central furrow.

Our Chilotes complained of having no food, of losing time, and especially of not having been advised of our boat to carry. This last they said they positively couldn't do and we believed them after our own experience with it. Arranged with Ignacio Chaure and party to take the little boat and we ourselves to start day after tomorrow, weather permitting. A few showers today and wind shifty. Chaure went up river today and killed an otter which I bought for 40 pesos.

Jan. 21. The fishermen left early this morning and also the men with our small boat. The weather looked good early in the morning but later was nasty and rainy and we didn't envy them their choice of a starting day. Put in the day finishing specimens, cleaning up and packing. Conover feeling seedy with slight chills and a bad stomach.

Jan. 22. No wind this morning and we were out at 3 and got everything packed into the boat and away at 6:25. The four Chilotes, 2 middle-aged men and 2 young fellows of 20 or thereabouts, took the great long oars and pulled away cheerfully. As we rounded the first point, Sanborn

Colin Sanborn poses with pudu fawn.

and Conover saw an animal on shore which they thought was a deer. The oarsmen worked like machines and we made fairly good progress. Saw many shearwaters or Sardelas, many penguins, cormorants, etc. The cormorants are of three species: one all black, one black with white underparts, and one with black head, neck and back and white belly. The last is the least numerous and perhaps is the common species of the Peruvian coast here near its southern limit. For several miles 4 or 5 porpoises played about our boat, frequently rising within 20 ft. Passing Ayentema there was quite a heavy swell but the well-loaded *chalupa* rode the rollers easily and as the tide favored us we made good progress. The *chalupa* is the boat of the country, made of native lumber, pointed at both ends, strong and seaworthy. They come in all sizes. A small one is a *chalupita* and a large one a *chalupon*. They remind of a dory somewhat. Ours carried 9 men and 1,500 lbs. of baggage quite comfortably and four oars propelled it at a good rate.

Coming into San Pedro channel a little south breeze appeared and we hoisted sail for a mile or so. Stopped at a little cove on San Pedro Id. to boil coffee and eat a snack and then went on, the Chilotes again taking the oars and pulling with a steady inhuman machine-like perseverance against both wind and tide. In the canal the current was strong and it was necessary to follow the shore closely in order to take advantage of the eddies and backwaters. The island of San Pedro is higher ground than any we have seen heretofore and the canal is quite picturesque with high banks on both sides on occasionally a rock too steep for any vegtation to maintain itself. Saw some peculiar red-faced grebes and some steamer ducks, one pair of which had a small brood of young which we failed to secure. They are said to make their nests at some distance from shore at the edge of the *monte* and their tracks on the adjacent beach give a clue to the situation. The young are now several weeks old. Our boy Juan says he has found nests with 6 eggs and once one with 12 which he thinks was due to 2 birds. At the eastern entrance to S. P. canal found a small whaling ship anchored. She hailed us and a motley crowd came to her side and asked if we had anything to sell such as fish or *mariscos* [shellfish]. Met a party from the lumber camp in the bay of Guandad and bought a spotted fawn pudu from them which they had just caught with their dogs. It was unhurt and exceedingly pretty, and I had it in my lap for much of the time for the rest of the way. Stopped just beyond the canal and cooked a good supper. I supposed the men would want to spend the night and start again tomorrow for they had been rowing hard and continuously for 12 hours, but no, they said it might rain tomorrow and they would go on tonight. So we started on just as it was getting dark and dozed or peered ahead at the dim outlines of the land, while the oars clicked regularly for five hours more and the heavy boat gradually gained on the wind and tide. It was a wonderful exhibition of strength and endurance and when one stopped to think that the wage of these men was only 3 pesos per day or about 25¢ Am. gold his sense of the topsyturviness of Chile was further increased. It was one of those nights that one remembers—a little drizzling rain, dark and misty, the shore looming up occasionally and then disappearing, long pulls for a point that seemed always a little further on, then the crash of waves on rocks awash as we actually reach the point and the panting cry of the bow oarsman as, without missing a stroke, he cried to the steersman to head "mas a fuera" [seaward] or "mas a orilla" [shoreward]. We were crowded on a pile of baggage in the stern, curled up in various positions—Conover and Sanborn tried to sleep but most of the time I found it too interesting and half reclined. The little deer rattled his tiny hoofs on the canvas when he got uneasy and at other times would lie quietly in my arms. It was chilly and wet but with several coats and sweaters on we didn't suffer.

Jan. 23. Arrived about 2 a.m. roused Don Ruperto for the key to our "cottage by the sea," spurred our jaded oarsmen to assist in carrying the baggage ashore and all hit the hay. This morning I got up to have some coffee and a fried egg with Ruperto but the others slept late. My offers for live deer began to materialize at once and by night, in addition to the fawn we had two more males, one fully adult and in fine dark coat, the other a younger male still shedding. A dead one came in also, a fine adult male and of this I saved both skin and a skeleton. Misty and showery most of the day.

Jan. 24. A busy day skinning deer etc. and trying to dry skins inside with a charcoal fire. Wind in west and rain by spells. Sanborn divided the outfit and got ready to leave on the *Arturo* which is expected tomorrow.

Jan. 25. *Arturo* failed to appear. Succession of showers most of the day. Bought a young coypu and added him to the menagerie. He snaps at us and growls and at times has a humming sound apparently from his throat. He also clicks his teeth to threaten. He did this when approached by the innocent little fawn which is ready to make friends with any other animal. Gave him a cabbage leaf and put him in a box. He finally ate the cabbage but didn't seem to care much for it. Later we found he had a great fondness for potatoes and by taking advantage of this we got him a little tamer so that with care we could touch him

without causing a rumpus.

Jan. 26. The *Arturo* came in about noon and Sanborn and Luis were all ready to start even rolling their beds, but the captain didn't like the weather and said they wouldn't go to Melinka until next trip. A little hail in one of the showers this afternoon. . . .

Young Ferenberg brought me the skin of a *Dromiciops*, badly prepared and without skull. They are said to live in holes in trees and to be "muy escaso" [very rare]. A story is current of one found in the center of a big tree when split open etc. as per usual.

Jan. 27 Sun and showers mixed today. Bought a chungungo or Gato del Mar today from some Chilotes who brought it in saying the *negocio* must be secret, evidently because they had been grub-staked by someone else. It is much smaller than the Huillin and darker in color. At night our livestock is hard to manage. The big deer got tangled in his rope and thrashes around on the hard floor making a terrific racket. The first night the fawn was alone and slept peacefully in the burlap . . . which I gave him. The next night he was in with the young buck and wandered about all night now and then crying with a plaintive little squeal. When introduced to the yg. buck he immediately prostrated himself to be licked and later tried to nuzzle him. The young buck treated him kindly and I tied them out under the same tree, but in a short time the little fellow began a continuous crying and has been uneasy ever since. It seemed as if the reintroduction to his kind reminded him of his mother. He is very nosy and curious and will poke about the room investigating everything and everybody. I can make him lie down by placing him on a mat and holding him forcibly until he gives up and stops struggling and crying and then he lies quiet and lets me stroke him or leave him there. Today it was rainy and we kept him inside where we were working.

Jan. 28. The little deer was sick this morning and after a while it was evident it was serious. We fed him a good deal of milk yesterday and played with him a lot. Once we caught him trying to eat an empty match box and very likely he got into something with arsenic in it. He was too weak to stand and we put him in the sun and he had a series of convulsions, kicking his little feet as if to be his end. Finally I had to kill him. Weather a little better today.

Jan. 29. Sanborn and Luis took the *Imperial* this noon for Melinka on a nice calm sunny day. Wilson wires that he will be here in a few days and since we have so many skins partly dry Conover and I decided to wait for the next boat.

Jan. 30. Fine weather again with a good south wind and snow mountains showing again on the far side of Corcovado Gulf. Skins drying nicely and boxes all fixed to receive them on short notice.

Jan. 31. More fine weather and it is evident the "tiempo esta fijo" [weather is stable] finally. Writing and doing odd jobs most of the day. Yesterday a coypu was killed on the main waterfront of Quellon, a rare occurrence. It was wandering along the shore and only took to the water when someone started a hue and cry and it was disabled with an oar. Bought it and skinned

and found a fine old male. Two *chalupas* of *gateros* [otter hunters] came in yesterday after a month's trip in the south, Huapiquilan, Guaitecas, Tic Toc, etc. They proceeded to get drunk and then to fight. The most popular drinking place is across the street from us and the excitement is nearby. They drink wine, whiskey, and pure alcohol and water. Altho very quick and shy when sober, they get noisy and quarrelsome when drunk. Took a few photos, went for a walk this afternoon to the hills back of town to take pictures and perhaps to pick up a scarce bird but had no luck. The appearance of the country is somewhat changed. The foxgloves have gone to seed and this makes a great difference. The grass is getting brown, the berries are ripening and it is the beginning of fall. A large composite with yellow flowers is blooming and at a little distance one might suppose goldenrod was here.

Feb. 1. A soft warm sunny day, as beautiful as the elements ever combined to make. A dead calm throughout the forenoon left the waters of the harbor serene and smooth. It was so inviting that some of the young people went in bathing, something probably rather rare in Quellon. Took a walk up the stream that comes in at the head of the bay. Found it very pretty, in places reminding of a good old-fashioned trout stream with riffles, pebbles, overhanging banks, grassy borders, etc., but soon got above this to thickets of quila and other brush. Shot a male specimen of the grosbeak we have occasionally seen but not obtained. The flycatchers are nesting now but almost everything else is through. In the estuary were the usual flocks of gulls. Many large reddish brown squid stranded at low tide. These are 2-3 ft. long and must be formidable appearing alive in the water. In the afternoon a brisk S.W. wind broke the bay into white caps and *chalupas* under full canvas were scudding about. Most of the population of natives here is in the islands Coldita, Cailui, and Laitec where they were originally on account the better grounds for shellfish. Don Ruperto says the whole district of Quellon has nearly 3,000 people but this hardly seems possible. In Quellon there can't be more than 5-600. In the evening a wonderful full moon. It seems like the tropic moon and much stronger than any northern moon.

Feb. 2. The *Huandad* came in at 11:30 p.m. last night and for a time we considered leaving in her, but she's such a lousy dirty tub, and we've still so many little things to do, decided to let her go and take a chance on the *Yates* being here soon, with the possibility also of seeing Wilson. Another beautiful day, but a few clouds hanging about the southern and western horizon. Snow mountains in the east clear and distinct. Spent the day packing and rearranging outfit. Found the last cornmeal in the office of *La Comunidad* where it had been all the time.

Feb. 3. More fine weather and nothing to do but sit and wait for the expected steamer. A rumor has it the *Yates* left Pto. Montt yesterday so she might get here today or tomorrow, but we believe nothing. Worked on accounts and wrote letters. A small boy brought in another of the big beetles known as "Cantarios" and I tried to kill it with tobacco smoke and later with hibach, but although these seemed to stupify it so it was still, it revived after a time and clawed the inside of the cartridge box in which it was confined. Many

Otter hunters of Quellon.

Boardman Conover relaxes as best he can on deck of S.S. Imperial *in Gulf of Corcovado.*

Chilotes in town looking for Wilson and again many drunks who got quarrelsome. They say there are not natives south of here except for the few about the Guaitecas with headquarters at Melinka. Formerly there was a tribe in the Chonos which used to come up here raiding and carrying off the women and goods of the Chiloe natives. This tribe is now extinct or absorbed with the people here. Quellon is really the southernmost natural settlement in Chiloe, since Aysen is a recent development under a company concession. Sixteen years ago, there were only three houses in the present site of Quellon. Quellon Viejo, a little to the east is older and shows on older maps, but it amounted to very little. There are now about 200 families in the town and about the bay.The school for boys has about 100 kids and that for girls 70. From this dope, Chiappa thinks the population must be about 2,000. *La Comunidad* is a combination of three companies which has a concession for lumbering over all of southern Chile from a point near Queilan south indefinitely. They paid a lump sum to the gov't (3 million pesos?) and seem to have control of land titles and everything and cannot be ousted except on 10 years notice from the gov't.

Had dinner tonight with Don Victor M. Chiappa, manager of the *Comunidad* here. Among other things he served a very delicious cordial made from the berries of the luma tree and native *aguardiente.*

Feb. 4. A few clouds this morning but perfectly clear later with a brisk west wind. After *almuerzo* [lunch], accepted an invitation to go on a family picnic with the Veras after being assured we could see the steamer if she should come in. Roamed directly across the bay to a sandy beach and lay in the shade of a flowering "*Erryon*" bush with the old folks while the younger ones went in bathing. Cooked a young lamb on spits and feasted on the roast with bread and wine, beer, and Chicha etc. with coffee + tea etc. A Dutch picnic with a South American flavor and both enjoyable and interesting. Still no steamer and patience nearly exhausted.

Feb. 5. Clear and warm again and more hopes for steamers. For awhile they came in here in flocks and now they seem never to come. Fleas are very bad here and we are hoping that Aysen may be too cold for them if we ever get there. Everyone tells us, the weather is very unusual, but it doesn't help us much, while we are sitting around waiting. The *Huandad* came in at noon looking dirtier and sloppier than ever after her trip to Aysen. At about 6 o'clock, the *Arturo* came again from Pto. Montt and left about midnight for Melinka.

Feb. 6. Strong SW wind and a few clouds about and a little cooler this morning. Played with a yg. parrot Conover bought from a boy yesterday. The *Yates* is lost somewhere and now we are looking for the *Imperial* again. "Arturo" came in just after dinner bringing Sanborn and Luis back from Melinka. They came ashore and spent the evening with us, reporting good luck with birds but not much with mammals, Sanborn being able to catch only a half dozen of one species of mouse. They went aboard again at 11 to leave "bien temprano" for Puerto Montt.

Feb. 7. Awakened at 5 this morning by whistling which I at first thought was the "Arturo" leaving but soon learned was the "Imperial" arriving in a great hurry. Piled out of bed and hustled things together for a quick get-away, paying bills on the dock and leaving our house in charge of the parrot. . . .□

Clean-up for the Mediterranean

by Norman Myers

Environmental efforts among the community of nations do not present a very good track record. Action plans to reduce transfrontier pollution, for example, are characterized as much by squabbles as by settlements. All the more welcome, then, is a remarkable campaign to clean up the Mediterranean. The strategy has been put together through some fancy diplomatic footwork on the part of the main international agency concerned, the United Nations Environment Program (UNEP).

The Mediterranean has recently become a cesspool for the 100 million people who live around its shores, and for those throngs who take their vacations in the region each year. As an enclosed sea—the only significant outlet is the narrow Strait of Gibraltar—the Mediterranean renews its waters roughly once every 80 years. This means that for the 18 nations bordering the sea, the present situation amounts to a case of "Let's get our act together, or we shall soon find ourselves with a killed-off ecosystem."

Few areas of the world are subject to as much human disruption as the Mediterranean. Although the sea is one of the world's main waterways for shipping, at least 85 percent of pollutants stem from land sources in the form of industrial waste, municipal sewage, and agricultural pesticides. Some 70 rivers, large and small, daily deposit thousands of tons of industrial effluents. At least 120 coastal cities and towns pump 90 percent of their sewage untreated, or at best little treated, into offshore waters. With only one percent of earth's ocean surface, the Mediterranean is believed to feature one half of all floating oil, tar, and general garbage that mess up the earth's seas.

Not surprisingly, the region is subject to several endemic diseases, including viral hepatitis, dysentery, typhoid, polio, and cholera. Spain recently suffered an outbreak of typhoid that hospitalized dozens of people. Along France's fashionable Côte d'Azur, sunbathers are warned off stained sands by black pollution flags, and swimmers are kept out of the most poisoned waters by police patrols. In 1979, 19 people in Naples died of cholera after eating contaminated mussels; and in Rome, as in Naples, you hear that if you order oysters in a restaurant you are playing "Italian roulette."

The Mediterranean harbors hundreds of fish species, many of them exotic enough to rank as luxury food items. While the annual catch amounts to only 2 percent of all fish taken around the world each year, its economic value is 6 percent, and is worth $1 billion. But now that mounting pollution is aggravating a history of overharvesting of fisheries, several species, notably the hake and the red mullet, have declined in just a few years from exceptionally abundant to almost extinct. Consumers in Spain, Yugoslavia, Greece, Turkey, and Israel complain that the price of fish on their dinner plates is several times higher than if the fish had been caught in the Atlantic.

Apart from pollution, the Mediterranean suffers from poorly planned tourism. Hotels, marinas, and other facilities are desecrating one natural area after another, disrupting wildlife communities right around the Mediterranean basin. The monk seal, flourishing in tens of thousands as recently as the early 1960s, is now below 1,000. A similarly dismal story applies to the marine turtle. Along coastal zones, there are growing threats for wetland species such as the spectacled salamander, the Iberian midwife toad, and the Israel painted frog, among 34 amphibian and reptile species that are rapidly losing living space. Likewise in trouble is the demoiselle crane, together with 200 other bird species in need of special protection. Among 12 endangered mammals is the Corsican red deer, having been elbowed to the edge of oblivion. On top of these vertebrates, there is a lengthening line of invertebrates whose numbers have been perilously reduced.

In 1975, UNEP started on what seemed an absurdly ambitious project. It wanted to persuade the 18 coastal nations to formulate a joint strategy to confront the challenge. In the event, UNEP succeeded in getting 17 of the nations (the one absentee was xenophobic Albania) to sit down and formulate a Plan of Action. UNEP's feat was all the more exceptional in that Israel eventually agreed to make common cause with its traditional enemies—Syria, Egypt, and Libya, as did Algeria with France and Turkey with Greece. Indeed, all the ages-long enemies of the region finally got together to prepare a collective clean-up program.

Since 1973, there has been a protracted process of scientific research, economic evaluation, and legal planning. The upshot has been an environmental breakthrough in late 1980, when a conference gathered in Athens. Sponsored by UNEP in conjunction with FAO and UNESCO, together with support from citizen groups such as the International Union for Conservation of Nature and Natural Resources, the conference agreed on a draft treaty, the final form of which came into operation in 1982.

The principal output of the Athens meeting has been a set of initiatives to tackle pollution. First of all there is a "black list" of contaminants that will steadily be eliminated from the scene by all source countries, especially by the three worst pollutors, France, Italy, and Spain. Included on the black list are mercury, highly toxic even in trace amounts, 100 tons of which are dumped into the sea each year; radioactive materials, of which 2,500 curies of radionuclides enter the sea each year; and a number of carcinogenic and mutagenic substances. A second "grey list" includes substances such as lead (3,800 tons dumped into the sea each year), zinc

Norman Myers, of Oxford, England, is a consultant in environment and development.

(21,000 tons), copper, titanium, crude oils and hydrocarbons, pathogenic microorganisms, nonbiodegradable detergents, and other substances (e.g. pesticides, 90,000 tons) that have an adverse effect on fish and shellfish—tuna, swordfish, and marine mammals contain 5 to 10 times more heavy metals than their counterparts in open oceans. Since these grey-list substances are less poisonous than the black-list items, and are more easily rendered harmless through natural processes, some of them can continue to be discharged into the Mediterranean—but only under strict scientific control and licensing procedures. A broadscale monitoring exercise has been launched, drawing on the coordinated efforts of 86 laboratories in 16 countries. International cooperation with a vengeance!

How soon will the Mediterranean be safe for local residents and tourists? According to Stjepan Keckes, a Yugoslav marine scientist who heads the UNEP team, "a lot of the Mediterranean might look clean, but there is 'invisible' pollution from heavy metals and bacteria. While it is an illusion to imagine that the Mediterranean will ever be pristine, we can reverse the tide of pollution, and guarantee safe, clean waters. Naturally this won't be done overnight. The skies of London were not made fog-free, or the River Thames safe for salmon, in a month or a year. But while the Mediterranean is sick, it is not yet dead. I believe we can make it a great deal better by the end of this decade."

In addition to antipollution measures, the treaty is setting up an expanded network of parks and reserves for wildlife. These will be located both in the sea and on land. The present handful of protected areas will eventually be increased to over 100.

The agreement of late 1980 goes way beyond the most optimistic expectations of observers, whether scientists, industralists, or politicians. In terms of environmental politics among the community of nations, it ranks alongside a disarmament agreement. There is hardly a region on earth with greater political disparities among countries in question, yet they have been persuaded to rise above their individual interests in favor of collective welfare.

True, the clean-up program will not come cheap. It will cost at least $15 billion during the next 15 years to control pollution alone. But the nations concerned cannot afford to turn away from the price tab of their past delinquency. The tourist industry alone is now worth $10 billion a year, and the flood of sun-seeking visitors is projected to double by the year 2000. So the clean-up plan can, in this sense, be considered an exceptional "cheapie." Fittingly, 85 percent of the funds are to be supplied by the three countries most to blame, France, Italy and Spain—these also being the countries with the biggest tourism industries. As UNEP's deputy director, Peter S. Thatcher, points out, "It is perfectly obvious that immense economic interests are involved. While the pollution controls will be gradual, they will represent a progressive process. Equally obvious, we are making a sound beginning."

The entire UNEP effort has attracted so many plaudits from cynical environmentalists around the world, that the Mediterranean blueprint is serving as a model for parallel programs in other regional seas. The Baltic became so fouled by 1970 that its fisheries virtually came to an end, but with sufficient political commitment and ecological know-how there is hope that they can be restored to life. The Caribbean probably features more rapidly growing coastal industry, especially in the way of superpolluting petrochemical complexes, than any other marine zone on earth—and the nations bordering on the Caribbean have received warning from the 140 million gallons of oil spewed from the Ixtoc oil well off Mexico.

There may even be prospect of a politico-environmental breakthrough in that region of extreme discord, the Persian Gulf. As an indication of the problems involved, it has taken four years to achieve agreement between the two main "sides," Iran and the

Demoiselle crane

rest. Part of the squabbling arose over the mere name: the word "Persian" did not please the Arabs at all, a switch to "Arabian" was strictly unacceptable to the Iranians, and the "Gulf" was intolerable all round. So the zone is now known simply as "The Region." Plainly, there is a premium on reaching agreement among the nations in question before a single oiltanker collision wreaks far more ecological injury than in most other parts of the marine realm. Yet, so keen are coastal states to achieve accord, that delegates from Iran and Iraq get together around a conference table, and greet each other with fraternal assurances, even while the two nations continue to wage war.

All in all, UNEP's Regional Sea's Program must count among the most remarkable of the agency's diverse activities. It accounts for a trifling part, less than one tenth, of UNEP's total budget, yet it advances with giant strides. Governments have agreed to Action Plans for clean-up programs in seven regional seas around the earth, and only three others remain to be tackled—but just think of the political complexities on the cards in the China Sea! Nonetheless, the ebullient Dr. Keckes is not to be daunted. An acceptable shopping list of initiatives for the Mediterranean would have been reckoned out of sight less than ten years ago.□

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Research Associate, Department of Geology

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COVER

Spring is upon us this month. What better symbol of that happy turn of events than the tulip. Photo by William Burger, chairman of the Department of Botany.

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Events

Special Events

"INDIA IN TRANSITION"
Sundays, March 20 and 27, 1:00pm,
West Entrance

As a complement to its newest exhibit, "Master Dyers to the World: Early Fabrics from India," which opened January 29 in Hall 27, Field Museum is screening three contemporary, feature-length Indian films.

March 20, 1:00pm "Dadi's Family" (58m)
A portrait of village women in India, and of a family in crisis.

"Pather Panchali" (112m)

Directed by Satyajit Ray, "Song of the Road" is part one of three feature length films that study the life of a Bengali village family.

March 27, 1:00pm "Manthan"
(The Churning) (134m)
"Manthan" was financed entirely by the farmers of Gujarat who donated two rupees each for the production of this film directed by Shyam Benegal. Benegal's concerns are the problems of caste which cannot be wished away.

These films are free with Museum admission and tickets are not required. The film program is partially funded by a grant from the Illinois Arts Council.

AFRICA: A CELEBRATION OF BLACK HERITAGE

"Music From the Bamboo Forest"
with Douglas Ewart and Inventions
Sunday, March 6, 3:00pm, James Simpson Theatre

Come and experience the delightful and lyrical music of Douglas Ewart and his group Inventions. The concert features multi-instrumentalist Douglas Ewart on winds and Hamid Hank Drake on percussion, along with special guest performers.

Ewart is a composer, performer, teacher, and instrument-maker who came to the U.S. from Jamaica, in 1963. He is president of the Chicago Chapter of the Association for the Advancement of Creative Musicians. Ewart has been active in the Chicago jazz "scene" since the mid-60s, recording with such greats as Muhal Richard Abrams, Anthony Braxton, Chico Freeman, Rosco Mitchell, and George Lewis.

This performance is partially funded by a grant from the Illinois Arts Council. Please use the attached coupon to order tickets.

Members: $3:00; nonmembers: $5:00

Highlights

NATURAL HISTORY FILM FESTIVAL
Saturday, March 5 and 12
1:30pm, West Entrance

This month concludes the showing of some of the most engaging and beautiful natural history films in the world. These films are made possible through Films, Inc. The film screenings are free with Museum admission. Tickets are not necessary.

March 5	*Ice, Wind and Fire* (from *Flight of the Condor*) (50m).
	The Mouse's Tale (25m).
March 12	*Signs and Signals* (from *The Discovery of Animal Behavior*) (50m).
	Flower from the Flames (25m).

"Fabric Fables" Family Feature
Sunday, March 13 and Saturday, March 19
1:00pm to 3:00pm, Hall 24, Second Floor East

India's fabrics are woven rich in age-old traditions. Since ancient times, a variety of colors, designs, and pictures have blended to tell the stories of India. Visit our current exhibit, "Master Dyers to the World: Early Fabrics from India." Find out how prints of peacocks, tigers, and elephant riders illustrate Indian folklore. Come to Hall 24 and make blockprint stamps so the entire family can print a decorative fable on cloth! Free with Museum admission. This program is partially supported by an Illinois Arts Council grant.

Weekend Programs

Each Saturday and Sunday the public is invited to explore the world of natural history at Field Museum. Free Discovery tours, demonstrations, and films related to ongoing exhibits at the Museum are designed for families and adults. Check the *Weekend Passport* upon arrival for complete schedule and program locations. These programs are partially supported by an Illinois Arts Council grant.

March 5 12:00 noon *Dinosaur Life Styles*
Tour contrasts old ideas about dinosaurs with new ones about their appearance, behavior, and environment.

March 6 2:00pm *Treasures from the Totem Forest*
A walk through the Museum's newest permanent exhibit introduces the Indians of southeast Alaska and British Columbia.

March 13 1:00pm *Hopi Ceremonial Life*
This 30-minute tour describes the life and religious ceremony of North America's oldest surviving culture.

2:00pm *Chinese Ceramic Traditions*
This 45-minute tour of masterworks in the permanent collection explores 6,000 years of Chinese art.

March 19 1:00pm *Ancient Roots of Modern Foods*
Learn how plant foods traveled to many parts of the world before they arrived on our own dinner tables.

March 20 12:30pm *The Brontosaurus Story*
30-minute tour looks at some of the newest discoveries about the "thunder lizard."

1:30pm *Fireballs and Shooting Stars: Keys to the Universe*
30-minute tour explains the origins, types, sizes, and importance of meteorites.

March 27 1:00pm *Wildflowers of Spring and Summer*
A slide showing of wildflowers you can see in the Chicago area.

Coming Events

The Queen's Garden
Dr. John Paling, Oxford Scientific Films, Ltd.
Sunday, April 17, 2:00pm
James Simpson Theatre

John Paling was a lecturer in zoology at Oxford when he became interested in the development of photographic techniques that would enable audiences to share the incredible sights of nature previously known only to scientists. Don't miss this opportunity to hear Dr. Paling who, since that time, has sought ways of producing spectacular footage recording the wonders of the natural world.

Members: $3.00; nonmembers: $5.00

Registration

Please complete coupon for your program selection and any other special events. Complete all requested information on the application and include section number where appropriate. If your request is received less than one week before program, tickets will be held in your name at West Entrance box office until one-half hour before event. Please make checks payable to Field Museum. Tickets will be mailed on receipt of check. Refunds will be made only if program is sold out.

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Field Museum of Natural History
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AYER FILM LECTURES

March and April

JAMES SIMPSON THEATRE

Saturdays, 1:30 pm

The entrance to James Simpson Theatre is conveniently located inside the West Entrance. This is of special interest to the handicapped, for the entrance is at ground level, with all steps eliminated. The West Entrance also provides free admission to the theatre. Access to other Museum areas, however, requires the regular admission fee (except on Thursdays) or membership identification. The film/lectures are 90 minutes long, and are recommended for adults. Doors open at 12:45pm.

March 5
"Mexico" by Robin Williams
Follow the coastline of Mexico from the Sea of Cortez to the Caribbean. Our journey begins at Loreto, first capital of the Californias and continues on to the land of the Maya—Uxmal, Chichen Itzá, Muna, Izarnal, and Cancún.

March 12
"Europe by Train" by André de la Varre
Take a ride on the world's fastest train, *Tres Grand Vitesse*, which reaches speeds up to 200 mph. Tracking through Europe, tour a czar's train, witness a Croatian wedding, attend a Yugoslavian wrestling match, and see how lace is made in Antwerp.

March 19
"Belgium" by Kathleen Dusek
Belgium is a land of two peoples—the Dutch-speaking people of the north and the French speakers of the south. Visit a lace-making school in Bruge, St. Bavo Cathedral at Ghent, and Antwerp's diamond industry center. To the south explore Waterloo, St. Jacque's Church at Liège, and Belgium's hub of activity: Brussels.

March 26
"California Wilderness" by Bob Roney
Within California's boundaries are the highest point in the United States, the lowest point in the western hemisphere, the Sierra Nevada, deserts, redwood forests, the Pacific coast and lush valleys. Discover the variety of plant and animal life that populates this rich landscape.

April 2
"Hawaii" by Frank Nichols
A visit to 4 of Hawaii's most beautiful islands where we see the orchid gardens of Nani Mau, King Kamehameha's birthplace, watch a Filipino community celebrate its 75th anniversary in Hawaii, and a Buddhist dance festival. The finale is a ride through Kauai's central mountains.

April 9
"Vancouver" by Tom Sterling
Sterling takes us to the rainforests and beaches of the Northwest Coast. On Vancouver Island we spend time with elk, deer, wolf, and a rare marmot. Traveling to Victoria, British Columbia's capitol, we meet orca whales, watch tufted puffins, peregrine falcons, and Steller's sea lions.

April 16
"The Naturalist Afield" by Steve Maslowski
Beginning in fall with a trip to Yellowstone and Teton National Parks, we witness the jousting of bull elk, the drilling for sap by the sweets-loving sapsucker, and the denning of foxes.

April 23
"The Three Rivieras" by Frank Carney
Travel to the Italian Riviera with its villages of the Cinque Terre and Michelangelo's marble quarries. The French Riviera offers a contrast between ultra-modern cities and quaint villages. We continue on to the Spanish Riviera, the Costa Brava.

April 30
"Mighty Mississippi" by Willlis Butler
Follow the Mississippi for almost 2,500 miles, from its source in Minnesota to the Gulf of Mexico. The color, sights, sounds, history, and music are presented to you as we travel back in history and into the future of this mighty waterway.

FIELD BRIEFS

Rare Medal Given by Member

Before moving to retirement on Merritt Island, Florida, Field Museum Member Mrs. Annie May Rosenberg gave to the Museum a bronze medal struck in Rome, Italy, in 1892, commemorating the World's Columbian Exposition.

Of rare numismatic value, the medal has been accessioned into the Museum's collections. It is now on display in Hall 3 with other memorabilia of the Columbian Exposition. It had been in Mrs. Rosenberg's family for many years, along with a first-day ticket to the 1893 Fair, which she also gave the Museum.

"Field Museum is my favorite museum," Mrs. Rosenberg said. "I want to give something to the Museum so that everyone may benefit from it." In addition to the medal and ticket, Mrs. Rosenberg gave precious metals and stock, proceeds of which she asked to be added to the Museum's General Endowment Fund.

The Museum currently is embarked on a program to increase the Endowment to help ensure the Museum's future. The Planned Giving Office invites bequests, gifts of life insurance, real estate, and cash or securities. Cash or securities may be exchanged for a life income trust to the donor, if desired.

The obverse of medal recently given to Field Museum by Mrs. Annie May Rosenberg.

Willard L. Boyd

1992 and Beyond

The following text is from an address given by Willard L. Boyd, president of Field Museum, at a recent meeting of the Economic Club of Chicago.—Ed.

Too often our vision of 1992 is limited in time and space. Our World's Fair must be the means for a greater end. It must be more than a Chicago carnival for the middlewest, more than a six months showcase for high tech and space exploration, more than a financial success. Like the Columbian Exposition of 1893, our Fair must be more than an event. It must be a watershed for the future. It must have enduring consequences for Chicago and serve as a world marketplace of ideas and ideals for the 21st century.

In planning for the Age of Discovery, we have much to learn from our forebears. Chicagoans have always been determined visionaries. Emerging from the fire of 1871 and in the middle of economic crisis, they conceived and held the World's Columbian Exposition of 1893. There were times when they and other American cities doubted Chicago's ability to host a Fair of global significance. Yet, their ambitions were limitless. After one planning session, Augustus Saint-Gaudens jubilantly proclaimed it to have been "the greatest meeting of artists since the fifteenth century." Indeed, the Columbian Exposition was a physical wonder. More importantly, it stimulated minds and aspirations for years to come.

Even before the Fair, Chicago's intellectual and business leaders realized that extraordinary natural history collections would be exhibited and that their presence in Chicago offered the opportunity to establish one of the world's great museums. The Field Columbian Museum opened in June of 1894 in the surviving Palace of Fine Arts Building, now the Museum of Science and Industry. Immediately before the Fair, the Chicago Symphony and the University of Chicago were organized and the Newberry Library came into being.

The original portion of the present Art Institute was built as the site for the World's Congress of Ideas, which was a major feature of the Fair. Among those who participated in the Congresses were Samuel Gompers, Frederick Douglas, Susan B. Anthony, Jane Addams, Woodrow Wilson, and John Dewey.

The arts were also well represented at the Fair. Paderewski performed the classics, while Scott Joplin played ragtime. The emerging American musical was represented by Lillian Russell and Florenz Ziegfeld, Jr. Women played a major role in the Congress and the Fair. Under the leadership of Bertha Palmer, they enlisted the participation of women worldwide.

The Columbian Exposition had a lasting effect on this city. It contributed enormously to the world's perception of Chicago. After the Fair, *Harper's Magazine* wrote: "The immediate future of Chicago is an interesting study for observers. . . . It is hardly too much to say that she has been the most important city in the land. . . . But what will become of her now? Will she drop gracefully down to hard pan and become once more a comparatively commonplace, big western town, or will she keep right on and strive by tremendous hustling to maintain the central and commanding position which was lent her by the Fair? . . ."

In 1933 Chicago celebrated a century of progress in a time of despair.

The Museum of Science and Industry and The Adler Planetarium opened their doors that year. The Lakefront was expanded. The Fair included a Hall of Social Science, because the depression had sharpened the interests of the public in social change. A Science Congress was sponsored jointly by the Fair and the American Association for the Advancement of Science.

Now we approach our Fair, and we do so in uncertain times. We fail our predecessors, we fail ourselves, and we fail future generations, if we are the first Chicagoans without dreams. But our Fair cannot be a straight-line projection of prior successes. McCormick Place is a continuous and impressive industrial and trade fair itself, Disney and theme parks have perfected the midway. EPCOT Center affords us a vivid view of the future. As Chicago undertakes the 1992 World's Fair, its unique asset once again is our city's individual and collective talent, imagination, and determination; 1992 gives us the opportunity to demonstrate to the world that we are still pioneers and that Chicago will lead in the next century.

Our Fair must generate its legacy, Our Fair must be as invigorating to succeeding decades as were the fairs of 1893 and 1933. Our Fair must make a difference in the physical and intellectual future of Chicago, a difference which the whole world can identify for many years, a difference which will not be eclipsed by the next fair in the next city.

Clearly, our Fair needs a major physical focus, a visible, unique, and lasting site. The site which has been selected cannot be matched anywhere for its combination of beauty, accessibility, and centrality. Chicago is distinguished for its lakefront, its cultural and educational institutions, its center city, and its diverse neighborhoods. These multiples make Chicago extraordinary, The selected site is best suited to strengthen all of these resources if we follow the proven advice of Daniel Burnham to make no little plans. His vision helped to make Chicago a worldly city, and it has not been rendered obsolete by the need for freeways and parking. Our task, in part, is to guarantee that there will be a vigorous population to use those freeways and parking lots in the year 2000. Chicago is coming to the end of an era, and we must make no little plans for a new era.

In recent years, Chicago center city planning has focused on the North Loop and the Near North Side. The Fair site provides the impetus for South Loop and near South Loop Development. The site allows us to expand our lakefront and to bring families to south Grant Park and Burnham Harbor for the day as they now go to Lincoln and other city parks. This expanded lakefront park can be connected on a east-west axis to a reborn South Loop and Near South Neighborhoods. Coordinated planning can be undertaken which will assure mutually harmonious development for Park District sports, McCormick Place, and the cultural institutions. To accomplish this, we must solve Lake Shore Drive problems in this area which are even more serious than the S curve to the north.

If we plan thoughtfully and jointly, we can benefit Chicago for generations. We can extend the beauty and recreation afforded by the lakefront. We can provide expansion for McCormick Place. We can provide the environment for present and furture cultural institutions to flourish in Grant Park as originally planned. The location of Adler Planetarium, Shedd Aquarium, and Field Museum of Natural History at the south end of Grant Park rounded out what (our urban historian) Carl Condit has called "the largest, oldest, and architecturally most impressive cultural center in the United States. The complex begins on the north with the (Cultural Center) and rings Grant Park along Michigan Avenue, including the Art Institute, Orchestra Hall, Fine Arts Building, and the Auditorium, winding up with the three institutions at the south end of the Park."

The success of this planning, the success of this Fair, and the success of this City depend on people. People, not structures, make a great City, make a great Fair. While we must, of necessity, fix Fair responsibility on a managing board of limited size, we must also have a participatory process which is open minded, open ended, open to all. In doing so, we recognize that today's eccentric idea is tomorrow's practical solution.

Our Fair needs to tap the talents and aspirations of people everywhere just as was done in 1893 by the World's Congress. This can be done simultaneously on the fair site and in the neighborhoods of the world. It can be done in fair buildings, it can be done in neighborhood halls, it can be done at home by television and computer, and we can be linked across the planet by satellite.

Aptly designated the Age of Discovery, the next Chicago World's Fair will emphasize human initiative and creativity. As in ages past so in ages future, people will be our greatest natural resource. In a time of limited physical resources, our future depends more heavily on our ideas and our ideals. We must explore the basic sciences, humanities, and arts through our educational, cultural, and research organizations. We must develop our individual ethics and mutual respect through our homes, churches, and communities. We must then apply our basic knowledge and basic values through the professions, business, labor, and government. We must learn to live together sensitively and sensibly in our neighborhoods, in our city, in our world.

The creative talents of all Chicagoans must be enlisted if our Fair is to open a new era. Groups, institutions, communities, and individuals should organize international symposia and local discussions and present world and local talent which will together enlarge and enliven our vision of the future. In doing so, we ought not spare ourselves. For as Christopher Columbus wrote his son: "If I failed to do something it was only due either (to) the impossibility of the thing itself or (to) its being entirely beyond my knowledge and my power. God requires in such cases only the will." If Chicago is the "I will" city, we shall realize that our Age of Discovery is our never-ending frontier. □

Collecting in the Upper Amazon

A Field Report from Timothy Plowman, Assistant Curator of Botany

Introduction by William Burger, Chairman, Department of Botany

Of all the land areas of our planet, the largest and least explored remains the Amazon Basin. From the eastern slopes of the Andes mountains in Bolivia, Peru, Ecuador, and Colombia to the shores of the Atlantic, this basin covers an area larger than the continental United States. It supports the largest evergreen tropical lowland forest in the world and the most poorly known. Rapid economic development is now making it possible to gather information in areas that were previously inaccessible or very difficult to reach. The Projecto Flora Amazonica *is a joint Brazilian-U.S. venture to collect information about this area through coordinated inter-institutional research programs and expeditions. Field Museum's Botany Department has concentrated much of its efforts on studying the plants of the American tropics. It is therefore appropriate that we are one of the institutions involved in this international research effort.*

Assistant Curator Timothy Plowman, now collecting in the Amazon Basin.

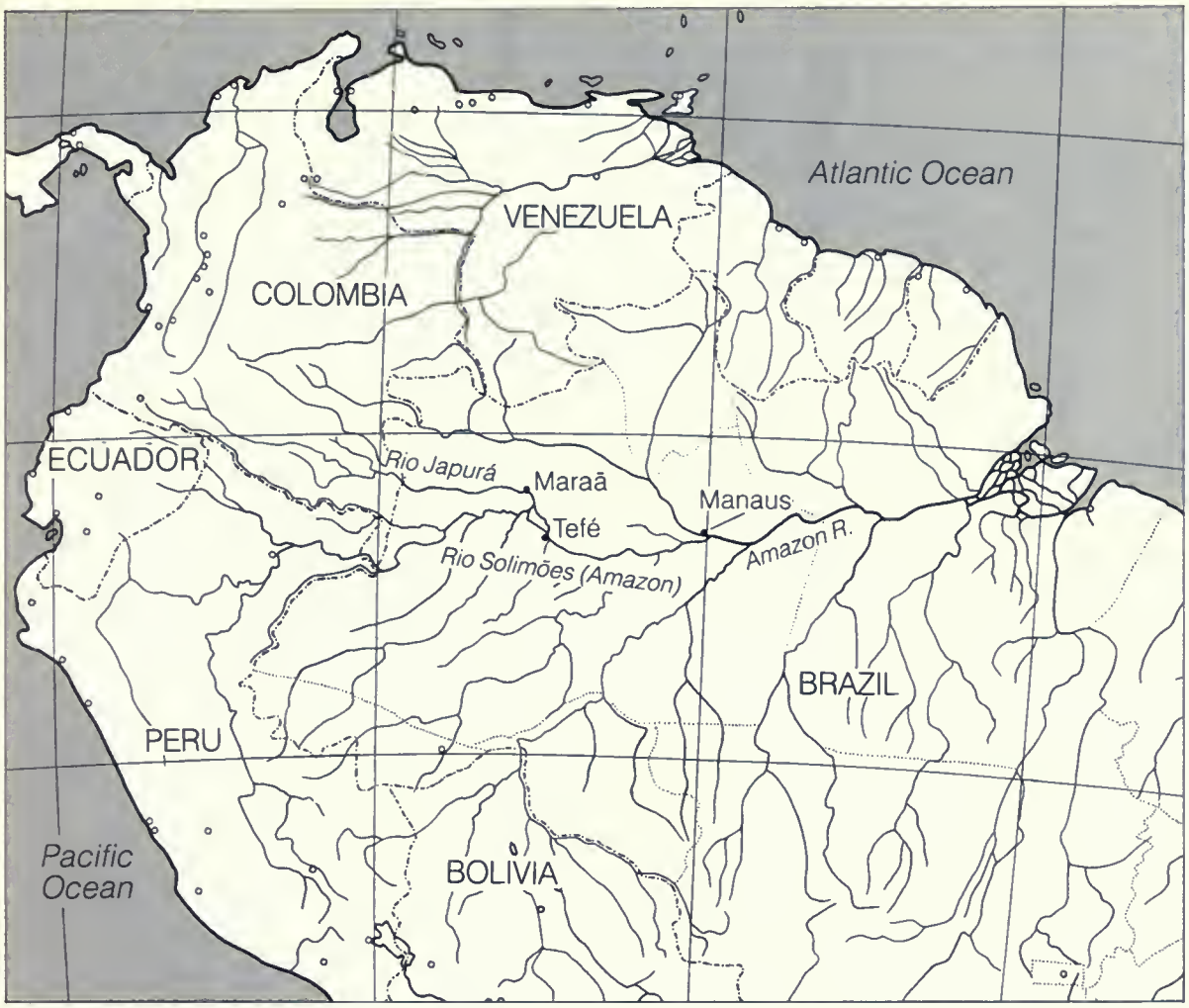
Dr. Timothy Plowman of our department is the Assistant Coordinator of the project's U.S. Committee and was with the latest expedition during December. The following letter describes some of his experiences at that time in the upper Amazon.—W. B.

3 Jan 1983 Manaus

Dear Bill:

Happy New Year though it's hard to believe it's 1983. Both Christmas and New Year's seem remote holidays in the steamy tropics, where every day seems like every other.

Our trip was really great although quite short because of the delay in our visas. Still, it seems like we were out for a couple of months, not weeks. We arrived in Manaus at the convenient hour of 3am to a rather unenthusiastic reception at immigration. My companion Wade was missing an important piece of paper in his file of documents, one which apparently was not returned from the Consulate in Toronto. I mustered as much of my rusty Portuguese as possible at that hour. After much grumbling and a long delay on the part of the Customs Officer, he stamped us in. I'm sure that a small propina would have helped matters immensely but I wasn't thinking clearly at the time. Bruce Nelson, our Projeto Flora liaison in Manaus, met us at the airport and provided a place to sleep that night. We left the next day by plane for Tefé, which lies about halfway between Manaus and the Peruvian border on the Rio Solimões (as the Amazon is called west of Manaus in Brazil). In Tefé we met our Brasilian colleagues, consisting of two trainee botanists from INPA in Manaus, two *técnicos mateiros* (general assistants), and the three crew members of our boat the *Pium*. The *Pium* is named for the voracious *no-see-um* so well known in these parts. It is an 18 m. long river boat, with one deck, an engine room, a galley and a toilet. We had a number of mechanical problems along the way but in general the boat was fine and just about the right size for our work. It did become rather crowded however, especially when we hired a local boy to serve as an axman-guide up the Rio Japurá our ultimate goal. We were then ten: at night when all the hammocks were strung across the boat, it was a major challenge to reach the back of the boat and the bathroom (especially amusing when we all came down



SOUTH AMERICA (northern)

with acute diarrhea). But everyone was very amiable and helpful and dedicated to making the trip a success. The Brasilian group had already been out in the field seven weeks collecting and waiting our arrival. Considering the close quarters, and long absence from home, everyone was surprisingly patient and good-natured. We spent just one day in Tefé while our mechanic replaced a part in the engine, and then took off for the Japurá. Tefé lies on the southern bank of the Solimões directly across from the Japurá delta.

The Rio Japurá is a northern tributary of the Solimões but runs parallel to it for much of its length. The Japurá originates in the Andes of southern Colombia, where it is called the Rio Caquetá. It is considered a "white water" river like the main Amazon but is considerably darker in color than the Solimões owing to the large number of "black water" rivers, which enter on the north bank of the Japurá. These resemble the waters of the Rio Negro basin which is the next river system north of the Japurá. The delta of the Japurá is an immense maze of channels and islands, well over 100 km. across. Navigating these waters takes a lot of experience, especially since there are virtually no conspicuous landmarks. We did in fact get lost one day in one of our outboards, when the *Pium* took a different channel than we did. The entire area of the lower Japurá is *várzea* forest, which is found in lowlying areas along the main white water rivers and is subject to several months of annual flooding. We arrived at the very end of the dry season, which we found out is not the optimal time of year for collecting. In any case the *várzea* is relatively uniform in species composition and also well known compared to the forests on terra firme. We spotted only a few small temporary settlements in the lower Japurá where people from other areas come to grow manioc during the low water. In general the whole lower part of the river is uninhabited by humans. During high water the waters from the much larger Solimões dominate the area and turn it into a river-lake some 15,000 km^2 in area, covered with forest.

The first terra firme on the Japurá appears about 150 km. from the Solimões, and then only the northern bank. We made some collections

Hall 29 diorama showing pond with typical vegetation in Upper Amazon region. Hall 29, featuring "Plants of the World," is now being reinstalled and will be opened later this year.

along the way upriver from our outboards, joining the *Pium* in late afternoon when we usually had a heavy thunderstorm. We had exceptionally good weather during our entire trip, but the rainstorms became increasingly frequent towards the end. Since we developed another engine problem, we decided to head for Maraã, the only "town" in this part of the river, and the first major settlement on terra firme. Maraã sits next to a large blackwater "igapó" lake fed by two sizable meandering streams. Maraã is one of those overgrown villages which can't handle becoming a town. There are just two main (mud) streets each three blocks long. The rest of the town consists of the church plaza and a rather nice little park on the riverfront. Away from the river, the town abruptly descends into a swamp. There is no real port, just a series of sidewalks which go down to the river. Since our generator was broken we had to plug into Maraã electric current. The town "electrician" came down to the boat and attached a long extension cord to a nearby public lamp post. No one seemed to mind and the next day other boats in port also tapped into the town generator.

We arrived (unfortunately for our peace of mind, but quite luckily for the crew) just in time for the start of the "Festa do Padoeira", an annual weeklong celebration of the town's founding, and the biggest event in Maraã of the entire year. Scores of boats began arriving from all over the Western Amazon, even from Colombia. Since the port area was tiny, there was a lot of crowding and elbowing for space in front of the town. Most of these were river traders, carrying such unsavory cargoes as *partially* dried *pirarucú*, the Amazon's largest commercial fish, leaky drums of gasoline, general merchandise and a healthy rat population. There arose a virtual rush of activity around town with the setting up of stalls for vendors throughout the plaza and waterfront. And many people starting arriving from the hinterlands, including a group of very acculturated Indians, who stayed at their own inn run by the government. The three bars/poolhalls in town were packed and there was even a dance at the local "nightclub" (written thus in English across the front of a completely empty wooden shack). An incredibly loud P.A. system was set up with constant announcements of the course of the festival,

interspersed with music played on not quite the right speed but a high volume. The local Padre, a Dutchman recently arrived from the Congo, monopolized the microphone to advertize his nightly bingo game. He was in desperate straits to pay for the recent paint job on his church, and managed to sell all of us bingo cards every night. Our Brasilian leader Cid won one night; the prize was a bottle of communion wine! All of this would have been great fun, except the port became very polluted very quickly and we all came down with dysentery. Fortunately we spent the days out in the forests and soon started to have our daily baths out in the middle of the Japurá from the outboards.

From Maraã, we were able to make day trips to a number of different areas and habitats. Across the Japurá were extensive várzea forests dissected with channels with connections to the Solimões; the flow of water through these was northward *into* the Japurá. The waters of the Solimões were immediately recognizable by their muddy *café au lait* color and by the great amount of debris, in the form of floating grasses and water hyacinth as well as quantities of dead logs and trees. The Japurá is a very "clean" river by comparison.

We concentrated our collecting efforts on the north bank and the terra firme habitats. The forests had been cleared only in the immediate environs of Maraã and its lake, and further afield only the large timber trees near the river had been cut. So we had easy access to handsome primary forests. Only a few scattered Canamarís Indians still live in this area, and as I mentioned they are highly acculturated. Still they know the trails well and still migrate for part of the year to the Rio Negro drainage to the north. Several Canamarís worked for us as guides during our stay.

Considering this was not a time of a flowering peak in the forest, we found a surprising number of trees in flower or fruit. Our main problem, and that faced by plant collectors throughout the tropics, was how to get specimens of the larger trees. The smaller ones we could reach with a tree pruner with extendable poles, or they could be cut down. But some of the choicest species, which we could spot with binoculars, seemed to flower only when they reached canopy height of 30-35 meters, and often up to 1 m. in diameter, or much greater if buttresses were present. We managed to cut down a few of the medium-sized trees with axes (our chain saw broke down early on), but this was extremely hard and time-consuming work. One tree might take two men an hour of steady chopping, if the wood was not especially hard. We simply did not have enough manpower to fell more than two or three large trees per day. The very big trees could only be appreciated through binoculars, although we did try several times to shoot down branches with a shotgun. For the most part, this is an ineffective and expensive technique. One advantage to felling the larger trees is that many other trees, as well as lianas and epiphytes come down with them, so we could usually count on at least ten additional, and often little known, species to accompany the explosive crash of a big tree fall. But with such logistical problems, it is no wonder the tree flora, which is by far the most diverse element here, remains incompletely known. One sometimes hopes to run into a limited clearcutting timber or roadbuilding operation to be able to make specimens of every tree as it comes down, but we did not have such (dubious) luck at Maraã.

The forests here are dominated by several plant families, and these varied only in relative frequencies from one locality to another. The most conspicuous are the Sapotaceae, Leguminosae, Annonaceae, Lauraceae, Burseraceae and Lecythidaceae. All of these groups are large tree families known for being notoriously difficult taxonomically, especially in the American tropics. Part of the problem in studying them is obtaining a reasonable sample of specimens due to the problems discussed above. Still there remains a tremendous diversity of species here, which only such intensive and extensive collecting expeditions will be able to uncover.

After our stay at Maraã, we headed back down the Japurá to Tefé. Both Wade and I would have liked to have proceeded to the Colombian border but our companions had already been there and our time was running short. We were obliged to return to Manaus before Christmas and it took at least a week of travel to reach Colombia. So that trip will have to wait until next time. We reached Tefé in just one day's time. We spent a day packing up many of our accumulated specimens and shipped them by air freight back to INPA headquarters in Manaus. The boat was beginning to get very crowded. Oddly, Tefé seemed like a thriving metropolis after Maraã. Tefé was known as "Ega" in the 18th and 19th century and was visited by von Martius in 1819 during his famous expedition to Brazil. The town has a few remnants of a previously elegant and important river town, back in the days of the Amazonian rubber boom. There are a number of beautiful and ornate turn-of-the-century port buildings along the shore, now deserted and crumbling, but still outstanding compared to the faceless concrete structures of recent years. Tefé sits on a high point of land at the mouth of Lago Tefé, which is

Forest view in Upper Amazon as conceived by 19th-century artist in Flora Brasiliensis *(1840-1906), edited by Karl Martin and August Eichler.*

protected from the main stream of the Solimões by a narrow island. It is still an important trading point but its products are now the less lucrative Brazil nuts and fish. Tefé is today a rather shabby town which seems not to have progressed during the past half century. It has an offensive odor because of the large storehouses of dried fish (primarily *pirarucú*) found here and the apparent absence of a functional sewage system.

As soon as we finished our town business, we left Tefé for the less populated areas across the Lake. Lago Tefé is about 55 km. long and around 8 km. across. It is said to be quite shallow but appears to be a very sizable body of water. It is fed by the north-flowing Rio Tefé and Rio Bauana, as well as many smaller rivers. The water is very dark but not muddy, similar to the Rio Negro, the lake is surrounded by large expanses of white sand beaches. Large areas of the upper reaches of the lake are flooded for most of the year and covered with a typical *igapó* type vegetation. *Igapó* differs from *várzea* only in that it refers to seasonally flooded forest on blackwater instead of whitewater rivers. Still, there are characteristic species which are found in each of these flooded habitats, and few that are found in both. We anchored the *Pium* next to a deserted white sand beach about 15 km. from Tefé. Previous residents had left plantations of limes, *abiu* (the *caimito* of Peru) and *cupuassú*, a relative of cacao with a large, woody fruit containing delicious white pulp. We still lived on the boat but spend most of our time on shore where we set up a specimen processing area under a grove of trees, certainly a much more pleasant working area than the rat-infested port of Maraã. The terra firme forests along the shores of Lago Tefé had been logged but we could appreciate their grandiosity from the size of Brazil Nut trees (*Bertholletia excelsa*) which are usually left for nut collectors who still harvest the world's Brazil nut supply from wild trees. Some of these reached two meters in diameter and dwarfed most of the remaining trees. Piles of cut-open Brazil nut pods found throughout the forest showed that these trees were still actively being harvested. The family composition of the forests at Tefé was similar to that of Maraã although we found a number of species not seen anywhere on the Japurá.

We made one day trip to the estuary of the Rio Bauana, which is a large black-water habitat without any noticeable current. This igapó lake is littered with the standing trunks of dead trees, with only a few living ones, of the widespread reverine legume *Macrolobium acaciifolium*. Between the standing tree skeletons were both living and dead individuals of a shrub (*Symmeria* sp?, Polygonaceae) which is also extremely abundant in these open flooded shallow igapó lakes. The remains of the dead trees and shrubs gave the landscape a strange and mysterious aspect. Among them were floating mats of two species of aquatic grasses both competing for living space by sending out incredibly fast-growing floating stolons along the surface of the water.

Partly because of the forbidding look of this "river" and because we had no idea which channel to take, we tried to find a local guide. We stopped at a small community on one of the few terra firme sites, which was clearly in the throes of the "morning after". One poor soul who could hardly stand up was appointed by an imposing patriarch. Still, he was able to point the way through a highly confusing maze of half-clear channels as well as through areas where we had to pole across grown over floating mats. We were rewarded along the way by a

fantastic display of bird life, especially herons, egrets and hawks. Finally we arrived at an Indian hut across the estuary where we found an accessible patch of terra firme forest. It was worth the trip because we found a number of species which did not occur along the middle and lower parts of the lake, including spectacular pink-flowered *Couratari*, a large tree of the Brazil nut family, and one tree for which the family still remains unknown to us.

A few days after arriving at Maraã, four of the botanists began to notice small patches of discolored skin in exposed areas. This was attributed to a small hymenopteran called *potó*, which issues a poisonous spray when disturbed. The insect was attracted to the lights on the boat at night and were so small and slender that they easily slipped through the holes in our mosquito nets. Our leader Cid had developed, by the time we arrived at Tefé, an ugly black edematous swelling on his forearm along with burning chest pains. Since he had only one arm, (childhood accident) he became especially concerned about what was happening. A doctor in Tefé pronounced leishmanniasis, which it was not, and we still believe that it was a severe reaction to the insidious *potó*. I developed an extremely itchy generalized rash over my arms, back, and legs which persisted until well after we arrived in Manaus. Cid decided to fly back to Manaus from Tefé, even though it was very difficult to get a seat on the plane because of the holidays. We left him on standby in Tefé and started downriver on the Solimões. We traveled all day and well into the night for two days. During the last half of the trip we were caught between two storms, one going up river and another going down, and it rained *torrentially* for the entire trip back to Manaus. The rainy season had definitely begun but we had been very lucky in enjoying almost ideal weather throughout our trip.

Now back in Manaus, we begin the long and tedious task of sorting the specimens (almost everything had been dried during the trip), and dividing them into equal sets for institutions in Brazil and the United States. The people at INPA, our host institution, have been extremely helpful. We feel especially grateful for having had such a congenial group of people to work with. Our final count of specimens collected is 2,014 different plants, with a total number of duplicates exceeding 20,000. Considering the frequent problems, bureaucratic, mechanical, medical and otherwise—we feel that it's been worthwhile.

Anyway all is well and I will leave Wednesday for Fortaleza, the interior of Ceará and Bahia, then Salvador, Ilheus and the institute of Cacao, and finally Rio at the end of February. Sorry about the typing job herein but you should see what I am using, and the way it fights back. Happy New Year. —*Tim*

View of Río Japurá, from Flora Brasiliensis.

1982 Volunteers Honored

On February 14, Valentine's Day, Field Museum honored its 300 1982 volunteers with a reception in Stanley Field Hall. Heart-shaped balloons fluttered as the volunteers and their guests visited with staff members away from the laboratories and offices where most volunteers contribute their time and talents. Volunteers in 1982 contributed a total of 46,556 hours, working in almost every department of the Museum.

Field Museum President Willard L. Boyd welcomed the volunteers and expressed, on behalf of the staff, the appreciation felt for their service. Museum Director Lorin I. Nevling, Jr. presented awards to two volunteers who have given fifteen years of continuous service to the Museum: Stanley Dvorak, Jr., a volunteer in the Invertebrates Division, Zoology Department; and Anne Ross, Department of Education.

Records show that Stanley Dvorak began volunteering at the Museum in 1967, but by then he was already an established Wednesday visitor in the division. An interest in marine shells first brought him to the Museum in 1953. At that time, the division had acquired more than two million new specimens in a decade, staff energies were devoted to processing the new material. Stanley worked through group after group, helping to identify material, offering new specimens to Field Museum from his own personal collection, and advising staff on purchases. When Stanley's interests developed in freshwater clams of local streams and lakes, he became the Invertebrate Division's "foul weather" friend. Wednesdays which were good weather days found Stanley off on a collecting excursion. Yet, Stanley found enough time in the last few years to allow him to review several collections of about 50,000 specimens of the beautiful Florida tree snails of the genus *Liguus*.

Although for a time Anne Ross led a double life at Field Museum—volunteering in both the Zoology and the Education Departments, most of her fifteen years of service has been in the Education Department. Anne was one of the first Museum volunteers to give educational programs to school groups. She was trained to give programs in all areas—biology, geology, and anthropology. As the Education Department's school programming expanded, most volunteers became specialists. But Anne continued to expand her repertoire and today is one of the few volunteers who can switch from "Egypt" to "Dinosaurs" to "Rocks and Minerals" at a moment's notice. Anne's dry humor and proven reliability has won her friends both in Education and in the Amphibians and Reptiles Division of Zoology, where she reorganized the reprint library a few years back.

Dr. Nevling personally presented gifts to those 1982 volunteers who had each contributed over 500 hours to the Museum. □

500 Hours or more

William Bentley; Anthropology: photographed artifacts in Asian collections.

Connie Crane; Anthropology: record-keeping; assisted with coordination of Maritime Peoples of the Artic and Northwest Coast exhibit; research assistant.

Jim Currey; Zoology, Mammals Division: skinned, fleshed, and prepared skeletal specimens; regasketed cases; record-keeping.

Lorna Gonzales; Zoology, Insect Division: recorded locality data for taxonomic and biogeographic study; checked localities on maps; entered computer data.

Margaret Martling; Botany: worked with type photography processing; reprint collections; identification of materials removed from exhibits; added new cards to reference files.

Rosanne Miezio; Zoology, Mamals Division: scientific illustration and photocopying.

Clara Richardson: Zoology, Fishes Division: scientific illustration.

Llois Stein; Anthroplogy: researched and catalogued Oceanic and African collections; assisted in Pacific storeroom reorganization.

Over 400 Hours

Louva Calhoun, Anthropology: illustrating and assisting with cataloging of the Isimila prehistoric collection.

Sol Century, Anthropology: accessioned and catalogued in general projects in Asian Division.

Patricia Dodson, Anthropology: office organization and coordination; proofing and editing manuscripts; bibliographic research; general office work.

Eric Frazer, Anthropology: worked on preventive conservation and textile storage.

Frank Greene, Jr., Geology: collected Mazon Creek specimens, recorded field distributions; cleaned specimens.

Dorothy Oliver, Library: indexed Museum's annual reports; assisted with interlibrary loan requests, filed new book cards; retrieved books for visitors; special projects.

Gary Ossewaarde, Education: researched and conducted weekend tours in anthropology; assisted in special events and workshops.

David Weiss, Anthropology: Administrative assistant in Asian Division; responsible for overseeing loans; miscellaneous correspondence, special projects.

Over 300 Hours

Dennis Bara, Membership: weekend membership representative.

Sanda Bauer, Anthropology: Record-keeping; assisted with Hall 10 exhibit; designed coloring book on Northwest Coast Indian art.

Sophie Ann Brunner, Zoology, Reptiles Division: skeleton preparation, organization, and maintenance.

James Burd, Anthropology: accessioned and catalogued in general departmental projects in Asian Division.

Dolores Fetes, Geology: compiling information for catalogue of fossil vertebrate type specimens inventorying; assisted with children's workshop.

Peter Gayford, Anthropology: cataloguing McCormick collection.

Halina Goldsmith, Education: conducted programs for school groups and public in Place for Wonder and in Maritime Peoples Hall.

Joseph Levin, Geology: cataloguing the John Clark collection of Oligocene mammals; reorganized fossil bird collection.

Melba Mayo, Education: conducted tours for school groups in anthropology and geology halls; gave public Highlights of Field Museum tours.

Withrow Meeker, Anthropology: preparation for Philippine exhibit; cataloguing Chinese paintings.

Carolyn Moore, Anthropology: special projects researcher in Asian Division.

Louise Neuert, Anthropology: worked on preventative conservation and storage of materials.

Forman Onderdonk, Education: gave programs to school groups and public in Pawnee earth lodge and in Maritime Peoples Hall; assisted with children's workshops.

Elizabeth Rada, Botany: organizing reprints and typing card index for reprint collection in Botany library; typing manuscripts.

James Skorcz, Library: worked in Reading Room; filled interlibrary loan requests, filed cards in card catalog, retrieved books for visitors; compiled statistics; special projects.

Charles Stanish, Anthropology: bibliographic research; analysis of field work; field work.

Zinette Yacker, Education: gave programs to school groups and public in Pawnee earth lodge and in Maritime People's Hall.

The following volunteers each gave over 50 hours in service to Field Museum in 1982.

ANTHROPOLOGY

Nathalie Alberts
Sanda Bauer
Dodie Baumgarten
William C. Bentley
Patricia Bercher
Marjorie Bohn
Julie Braun
James E. Burd
Louva Calhoun
Sol Century
Margaret Chung
Connie Crane
Jeannette DeLaney
Steven Diamond
Patricia Dodson
Nancy Fagin
Eric Frazer
Peter Gayford
Helen Gayner
Dorothy Haber
Anne Leonard
Virginia Leslie
Michelle Leuallen
Susan Lynch
Withrow Meeker
Carolyn Moore
George Morse
Louise Neuert
Ernest Newton
Herta Newton
Dorothea Phipps-Cruz
Philip Pinsof
William Rom
Robert Rosberg
Sara Scherberg
Charles Stanish
Eric Stein
Llois Stein
James Swartchild*
Cathy Tlapa
Paula-Ann Vasquez-Wasserman
Alice Wei
David Weiss
Reeva Wolfson

BOTANY

Virginia Beatty
Cecilia Bodman*
Stephen Dercole
Phyllis Dix
Deborah Green
Mary Lou Grein
Caroll Henry
Marion Lehuta
Margaret Martling
Elizabeth Rada
Barbara Siekowski
Lorraine Thauland
Lillian Vanek
Fred Weiss

BUILDING OPERATIONS

Charlotte Morton
Helen Ruch

BULLETIN

Hermann Bowersox

EDUCATION

Dolores Arbanas
Jacqueline Arnold
Terry Asher
Margaret Axelrod
Beverly Baker
Lucia Barba
Gwen Barnett
Winifred Batson
Elaine Bernstein
Sharon Boemmel
Sandra Boots
Charles Braner
Carol Briscoe
Teddy Buddington
Steve Buehler
Mary Ann Bulanda
Carol Bunting
Mary E. Burt
Joseph Cablk
Kathy Cagney
Susan Matthys Curran
Eleanor DeKoven
Carol Deutsch
Marianne Diekman
Delores Dobberstein
Caryn Doniny
John Dunn
Jean Durkin
Lynn Dyer
Alice Eckley
Ruth Egebrecht
Anne Ekman
Jennifer Elliott
Agatha Elmes
Jean Ettner
Nancy Evans
Martha Farwell
Ruth Fouché
Gerda Frank
Janine Fuerst
Shirley Fuller
Miriam Futransky
Bernice Gardner
Suzanne Garvin
Nancy Gerson
Delores Glasbrenner
Halina Goldsmith
Helen Gornstein
Evelyn Gottlieb
Ann Grimes
Karen Grupp
Michael Hall
Barbara Hathaway
Shirley Hattis
Audrey Hiller
April Hohol
Zelda Honor
Scott Houtteman
Betty Hubbard
Ellen Hyndman
Micki Johns
Nancy Jonathan
Malcolm Jones
Carol Kacin
Elizabeth Kaplan
Dorothy Kathan
Shirley Kennedy
Barbara Keune
Marjorie King
Dennis Kinzig
Alida Klaud
Glenda Kowalski
Teresa LaMaster
Carol Landow
Joan Lauf
James Lowers
Ruth Luthringer
Margaret Madel
Sara Majer
Gabby Margo
Melba Mayo
Marita Maxey
Mark McCollam
Carole McMahon
Beverly Meyer
Reed Millsaps
Anne Murphy
Charlita Nachtrab
Linda Nard
Mary Naunton
John Ben Nelson
Mary S. Nelson
Forman Onderdonk
Joan Opila
Marianne O'Shaughnessy
Gary Ossewaarde
Anita Padnos
Raymond Parker
Michelle Parker
Frank Paulo
Steffi Postol
Jacquelyn Prine
Ann Ratajczyk
Ernest Reed
Elly Ripp
Laurel Rippey
Barbara Roob
Kathy Rose
Beverly Rosen
Sarah Rosenbloom
Anne Ross
Susan Rowley
Lenore Ruehr
Linda Sandberg
Marian Saska
Everett Schellpfeffer
Marianne Schenker
Jessie Sherrod
Florence Selko
Judith Sherry
Dorothy Skala
Deborah Silber
Doris Simkin
Beth Spencer
Irene Spensley
Robyn Strauss
Bea Swartchild
Mary Alice Sutton
Jane Thain
Patricia Tyson
Barbara Vear
Charles Vischulis
Bertram Walton
Harold Waterman
Bob Weicherding
Mary Wenzel
Scott Willsey
Zinnette Yacker

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Steven Johnson
Diane Jurado

FIELDIANA

Donald Gemmel

GEOLOGY

John Bauer
Joan Biba
Jean Carton
Lynn Dyer
Kathleen Early
Linda Egebrecht
Dolores Fetes
Marie Fischl
Louis Galvez III
Frank A. Greene, Jr.
Cecily Gregory
Carol Hallow
Calvin Harris
Harold L. Honor
Paul Kenneth Johnson
Gerald Kuechner
Joyce Kieffer
Joseph Levin
Alice Mills
Rose Ocampo
China Oughton
Therese Palmer*
Susanne Petersson
Jean Porretto
Sarah Powell
Ann Rubeck
Thelma Schwartz
Lynn Siegel
Steven Sroka
Patricia Talbot
Mary Ann Walkosz

HUMAN RESOURCES

Andrea McDonald

LIBRARY

Arden Frederick
Claxton Howard
Ruth Howard
Mabel Johnson
Dorothy Oliver
Marie Louise Rosenthal
James Skorcz

MEMBERSHIP

Carrie Anderson
Dennis Bara

PLANNING AND DEVELOPMENT

Robyn Michaels
Kathryn Mozden
Jacqueline Tracy

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Gay Voss
Reeva Wolfson

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Gladys Boyd
Camille Bzdek
Suzanne Pier Fauteux
Yvonne Gonzalez
Doug Jacobs
Frank Leslie
Jennifer Newman
Gloria Taborn
Osa Theus

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Loretta Green

TOURS

William Roder

ZOOLOGY

Neal Abarbanell
Mario Ambrosino
Lawrence Berman
Steve Brady
Joseph Browne
Sophie Ann Brunner
Jim Currey
Stanley Dvorak
Andrea Gaski
Marty Germann
Christine Geymer
Elizabeth Louise Girardi
Lorna Gonzales
Greta Gratzinger
Henry Greenwald
L. James Hitz
Nancy Hubbard
Jennifer Ikerd
Malcolm Jones
Carole Kamber
Dorothy Karall
Lisa Leslie
Elizabeth Lizzio
David Matusik
Rosanne Miezio
Doris Nitecki
Edwardine Nodzenski
Miles Olson
Laura Pederson
Robert Protosevich
Sri Raj
Lee Rapp
Sheila Reynolds
Clara Richardson
Jim Sipiora
Lorain Stephens
Rita Veal
Virginia Vergara
David Walker
Hal Waterman
Mary Wenzel
Philip Woutat
Katherine Wright

Deceased

A nineteenth-century view of the Great Flood, with Noah's Ark in the background. The bloated corpses of larger vertebrate animals have risen to the surface. Creationists have used such scenarios to explain the abundance of vertebrate fossils in the upper (younger) parts of the geologic column. (Courtesy Historical Pictures Service—Chicago.)

Geology and Creationism

by
David M. Raup

Introduction

This essay is inspired by my rereading of *Science and Creation*, by Boardman, Koontz, and Morris (1973). *Science and Creation* is not the most recent treatment, but it is one of the best in the sense of being a clear and unambiguous statement of the case made by contemporary creationists against the conventional wisdom of evolution. The same basic ground is covered by later books, such as those by Wysong (1976) and Gish (1978).

I will be concerned here only with the strictly geological and paleontological parts of the argument. Thus, I will not consider such diverse questions as the origin of life, the origin of DNA, applications of the first and second laws of thermodynamics, elaborate probability arguments, and so forth. I doubt if there is any single individual within the scientific community who could cope with the full range of arguments without the help of an army of consultants in special fields.

The Main Arguments of Scientific Creationism

The geological and paleontological

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"Geology and Creationism" is adapted from the essay "The Geological and Paleontological Arguments of Creationism," by David M. Raup, appearing in *Scientists Confront Creationism* (W.W. Norton, 1983), edited by Laurie R. Godfrey. Copyright © 1983 by Laurie R. Godfrey. Reproduction, in whole or in part, without written permission of editor and publisher is strictly prohibited.

arguments made by scientific creationists vary somewhat from author to author, and many rather long lists of presumed failings of the rock and fossil records have been published, but there is a group of recurrent arguments which I will discuss under four main headings.

1) *Evidence of catastrophe in the fossil record.* It is a common plea of the creationists that the geological record shows ample evidence of very sudden events and they consider this anathema to the rather gradualistic, uniform processes of geology and evolution described in many basic textbooks. The examples presented by the creationists are legion, but emphasis is usually given to what are referred to as *fossil graveyards;* that is, those situations where there is evidence of sudden annihilation of populations of single species or of whole communities. The preservation of Pleistocene mammals in the tar pits at La Brea is one of many cases often cited. Emphasis is also given to *polystrate fossils.* This refers to situations where a single fossil specimen, such as an upright tree trunk, cuts across or is included in rocks covering a significant span of geologic time. The creationists point out, probably correctly in most cases, that the occurrence of a long tree trunk in life position suggests extremely rapid deposition of the surrounding rock. Otherwise, the tree trunk would have decayed and disappeared before it could be embedded. Fossil graveyards and polystrate fossils are combined to argue for the general principle that most fossils are the result of some unusual, short-lived event and do not represent a gradual or uniform process.

In a slightly different context, *ephemeral markings* are often cited as evidence of catastrophe. These include such sedimentary features as ripple marks, rain drop impressions, and mud cracks. Also included are footprints (of dinosaurs, for example) and a host of other biological markings. The argument is again made that these tracks and trails could not be preserved without some sort of unusual catastrophe.

2) *Relative dating based on fossils.* As is well known, geological dating normally takes two forms: *relative dating* developed empirically from the sequences of fossils and *absolute dating* based on a variety of techniques yielding an age in thousands or millions of years. The scientific creationists have long criticized the system of relative dating based on fossils. One of their arguments is the claim that the basic reasoning is circular: that a geologist identifies fossils as being of a certain age only because those fossils have been found only in rocks of that age. In addition, the creationists note that the entire column is never found in one simple stack and that the geologic column of the textbooks is actually a composite built up from small segments scattered around the world. The creationists argue that there is a large element of inference in the process of building up the chronology and they have been quick to find fault with many of the details of the composite, or standard, column.

One also runs into the argument that the system of relative dating is circular because it assumes evolution; that is, fossils are placed in the sequence by their "stage of evolution" and the sequence itself is later used as evidence for evolution. As will be shown below, this particular point is a misunderstanding of the way geology works. Rarely, if ever, is the stage of evolution used as a means of placing a fossil in the geologic time scale.

3) *Absolute dating.* This is a complex subject and creationists' arguments deal primarily with alleged discordances or incompatibilities of dating methods using radioactive isotopes. The basic argument is that the number of inconsistencies in radiometric dating is great enough to disqualify the method.

4) *Disagreement between the fossil record and the predictions of Darwinian theory.* To the scientific creationist, the Darwinian theory of evolution predicts that we should find in the fossil record a continuous chain of evolutionary stages with ample intermediate or transitional forms between major groups. For authority, creationists quote Darwin and indeed it is a simple matter to find in Darwin's writings the prediction of gradual evolution with intermediates strung out as beads on a string. The creationists then point to the rather sudden appearance in the fossil record of many new groups and the general lack of intermediates as evidence that Darwinian theory does not hold up. Also, in a slightly different vein, the creationists cite the so-called living fossils: those organisms that have shown little or no change through long periods of geologic time. It is not clear to me that Darwinian or neo-Darwinian theory predicts that evolutionary change must occur—so the living fossil argument may be a straw man.

Later in this essay I will consider the several arguments just presented in greater detail. But first, a couple of other elements of the problem should be considered. One is a list of arguments *not* made by scientific creationists and the other is the general question of whether the scientific creationists are indeed behaving in a scientific fashion.

Arguments Not Made By the Creationists

One irony of the current debate be-

tween the evolutionists and creationists is that the evolutionists often allege a number of arguments they assume the creationists are making but which, in fact, are not being used by the contemporary breed of scientific creationist. Let me single out the most important of these.

1) *The Bible as the only authority.* The Biblical accounts of creation and of the history of the Earth are often cited in the literature of the scientific creationists. Many creationists obviously believe that the Bible is correct in every detail. In fact, to become a member of the Creation Research Society one is obliged to subscribe to a Statement of Belief which includes agreeing that "the account of origins in Genesis is a factual presentation of simple historical truths." With this as background, the creationist could be content simply to present, and perhaps interpret, the Biblical account and leave it at that, with no reference to observational data from natural history. But this is not the approach. Rather, the Biblical account is used as a model or hypothesis and its predictions are tested with data from geology, paleontology, and other fields.

Several lists of predictions of the creation model have been published (Gish, 1978, pp. 50-51, for example). Testing these predictions often involves rather elaborate, and surprisingly conventional, research studies. A recent example is a reappraisal of the well-known limestone deposits of Silurian age at Thornton Quarry in Illinois (D'Armond, 1980). These deposits are conventionally understood to be buried reefs, and extensive work has been done on them over many years. D'Armond attempts to argue that the deposits are simply the result of catastrophic flooding and while I do not agree with his analysis or his conclusions, the study is clearly an attempt to use geologic data to prove an aspect of the creation model.

Thus, while most practitioners of scientific creationism firmly believe in the authority of the Bible, they are not relying on it as the sole authority. Rather, they are searching for corroborative data from a wide range of sources. Theoretically, a creationist such as D'Armond could conclude that the creation model is not viable because of a lack of corroboration from geological data. This is very unlikely for the committed creationist, but the literature of scientific creation does provide the interested layman with the opportunity to conclude that the Biblical account is falsified by scientific data.

2) *Natural selection denied.* It comes as a great surprise to many evolutionists that contemporary scientific creationists do in fact accept Darwinian natural selection and its modern genetic basis. That is, they grant that populations of species are variable, that the variability is heritable, and that through natural selection, evolution from one form to another takes place. Thus, classic cases of natural selection (such as industrial melanism) do not bother the creationists. In fact, their textbooks often

Rancho La Brea tar pit, near Los Angeles. A "fossil graveyard" of Pleistocene mammals commonly cited by creationists as evidence of sudden annihilation of entire communities of animals. Photo courtesy George C. Page Museum, La Brea Discoveries (branch of the Los Angeles County Museum of Natural History).

include exhaustive and rather good treatments of the works of geneticists and population biologists on natural selection. The creationists do draw the line, however, at using natural selection to explain the origin of major groups (families and orders).

The foregoing can be illustrated by quoting from Boardman *et al.*, (1973, pp. 39-40):

"Creationists recognize that variation and mutation and natural selection are real processes but they feel that evolutionists are not justified scientifically in extrapolating from the essentially trivial cases of mutation and natural selection which can be observed to occur in the present world to the gigantic sequence of evolutionary changes which must have occurred in the past if the organic world is to be accounted for on this basis... When all is said and done... examples of supposed present-day evolution that are commonly cited in textbooks are actually nothing but relatively minor variations within the originally-created kinds... Essentially stability of the created kinds is postulated, though with a wide range of adaptive variety possible within the kinds...."

It is thus the creationists' argument that the basic groups of organisms were created separately and that each created kind has undergone modification by perfectly conventional Darwinian means.

3) *Single catastrophe required.* The creationists rely heavily on the idea that a single major flood was responsible for much of what we see in the geologic and paleontological records. This is inspired, of course, by the famous Noachian Deluge but the important element here is that the creationists do not insist that there be only one such flood, but rather, they claim one large flood followed by an attenuated series of smaller floods. They argue that the preflood condition—an Earth covered by crystalline rocks—lasted for some thousands of years and that this was followed by several months of flooding (Wysong, 1976). The flooding is seen as producing the complex stratigraphy of sedimentary deposits that historical geologists and paleontologists deal with. Although there is some disagreement among creationists, the consensus is that there were a number of floods subsidiary to and following the Flood of Noah.

Are Scientific Creationists Scientific?

It is commonly argued by the evolutionists that the creationists' arguments are not worthy of discussion in a scientific context because they are not using scientific methods and their work is thus not science. As this argument goes, the forum for the debate—if there is to be one—should be in the arena of religion and philosophy rather than science. To support this general point of view, it is often argued that the creationists have allegiance to a single ideology (the Bible) and are thus not free enough intellectually to consider questions of origins in a scientifically acceptable manner. It is also alleged that the arguments made by the scientific creationists are almost all negative ones and thus do not constitute science. Whether these arguments have validity surely depends upon which scientific creationists are being evaluated.

There is no question that there is a strong correspondence between support of the creationist idea and commitment to a single religious view. Increasingly, however, people without strong religious commitment are being drawn into and are expressing some acceptance of the arguments made by the scientific creationists. Therefore, control by an ideology may represent an argument in some quarters but certainly not all. Furthermore, I think it can be argued that whether a body of reasoning is scientific or not should stand on its own merits rather than on the question of whether the adherents are committed to one ideology or another. Many excellent scientists would also fail a test of personal ideology.

In my view, a number of the arguments used by the creationists are scientific in the sense that they use the basic methods of reasoning and of testing hypotheses normally considered to be scientific. This does not mean, of course, that the conclusions are correct. Bad science may be just as scientific in the sense of methodology as good science.

In spite of my claim that at least some of the scientific creationists are behaving scientifically, they have some major problems in execution. Some of these are simple errors of fact or understanding of the way in which evolutionary biology and paleontology are done. For example, it was noted earlier that scientific creationists argue that it is invalid for geologists and paleontologists to determine the age of fossils on the basis of some presumed level or grade of evolution. This is a clear misunderstanding of the way geology and paleontology operate. The development of the relative time scale for the fossiliferous part of the geologic column is purely empirical. The fossils could just as well be any sort of funny marks on rocks, unrelated to biological entities, as long as they are non-randomly distributed in time.

Other errors of fact are illustrated by the often quoted co-occurrence of dinosaur and human footprints in Cretaceous limestones of Texas. This is one of many instances where lack of paleontological training and lack of experience with fossilization have led the creationists astray. In this particu-

lar case the dinosaur footprints are real but the human footprints are not, or at least that is the judgment of vertebrate paleontologists who have worked extensively with fossil trackways of terrestrial tetrapods. So, although the scientific creationists have done a rather remarkable job of absorbing a complex discipline, some errors of fact and of understanding have crept in.

A more serious deficiency in the scientific method used by the creationists is their repeated insistence on experimental evidence and their insistence that there be no exceptions. The creationists are fond of claiming that in order to be scientifically demonstrable, something must (1) be amenable to proof by experiment and (2) without exceptions. These requirements are probably valid in certain areas of science, particularly in parts of physics and chemistry and in certain areas of engineering. What the creationists seem to miss is the fact that geology and paleontology are historical sciences and therefore experimental testing of predictions is difficult if not impossible and that these sciences rely largely on statistical inference; that is, on the building of a general case which accepts exceptions as tolerable.

In this context, the kind of inference made by geologists and paleontologists is not unlike that made in clinical medicine where both diagnosis and treatment are extremely inexact and individual decisions may depend upon assessment of probabilities and predictions which may, in many cases, turn out to be incorrect. The "batting average" is high enough in most areas of medicine to justify these fields as being not only scientific but well worth the effort. Clinical medicine is often an historical science in that inferences and generalizations are based on past events which were totally unplanned.

Let me give an example in a geological context. The basic geologic column was developed on the assumption of the so-called Law of Superposition. This law simply says that younger rocks are deposited on top of older rocks and therefore that if one finds a sequence of rocks, the youngest are at the top and the oldest are at the bottom. This is not a very profound law but it has been extremely useful and was vitally important in the development of the geologic time scale. Not uncommonly, however, demonstrably young rocks are found *beneath* older rocks. Often, the reason for this reversal of the expected sequence is clearly the result of movement of the rocks by tectonic forces after deposition, specifically by thrust faulting (where one set of rocks is literally thrust up over a younger set of rocks long after the original sequence was deposited). Under ideal conditions, one can find clear evidence of thrust faulting and can even identify the surface along which the movement took place. In such situations, the reversal of the order is not a meaningful exception to the Law of Superposition.

What the creationists seem to miss is the fact that geology and paleontology rely largely on statistical inference; that is, on the building of a general case which accepts exceptions as tolerable.

With many well documented cases of thrust faulting in hand, the geologist feels confident to interpret a reversed sequence as the result of faulting even though actual evidence of the fault cannot be found in the particular case. This practice is dangerous, of course. It could be that the interpretation of such discordant sequences is in error, but the geologist is comfortable with the reasoning because the number of unexplained exceptions to simple superposition is very small compared with the number of situations where the expected sequence is found or where a clear explanation for the disturbed sequence is available. It is in this sense that the geologist is making a statistical argument when he interprets a reversed sequence by recourse to thrusting.

The creationists appear content to cite one or a half dozen unexplained cases of reversal to disqualify the whole system of geologic chronology. Actually, what they should be trying to do is build up a statistical argument wherein the number of unexplained exceptions is so large as to jeopardize the entire reasoning. They have not been able to do this and I suspect they have not tried because of their basic thesis that a theory or law can be brought down by a small number of exceptions.

In summary, my feeling is that the better students of scientific creationism are using scientific methods, but not using them well.

The Rocks and Fossils Say Yes!

In this section I will attempt to respond to the four main arguments of the scientific creationists presented earlier in this essay. The responses will perforce be limited and general but I hope they will answer the major points satisfactorily.

Catastrophism. The catastrophism argument is a straw man. In the nineteenth century, the combination of Lyellian geology and Darwinian biology did promote a

conventional wisdom that the Earth and life evolved by very gradual processes moving at uniform rates. Many of the examples of catastrophism now being cited by the scientific creationists were well known but either ignored or given very secondary importance in nineteenth century geology and paleontology. A great deal has changed, however, and contemporary geologists and paleontologists now generally accept catastrophe as a "way of life" although they may avoid the word catastrophe. In fact, many geologists now see rare, short-lived events as being the principal contributors to geologic sequences. In many instances, an exposure of rock records a series of special events (storms, hurricanes, land slides, slumps, or volcanic eruption) which produced large volumes of sediment but which represent only a fraction of the elapsed time covered by the total sequence. The periods of relative quiet contribute only a small part of the record. The days are almost gone when a geologist looks at such a sequence, measures its thickness, estimates the total amount of elapsed time, and then divides one by the other to compute the rate of deposition in centimeters per thousand years.

The question then is *not* whether catastrophes occurred (including large floods) but whether they were relatively few in number, with one large flood dominating geologic history. Assuming that our geologic time scale is reasonably accurate, geologists and paleontologists have identified many thousand separate catastrophic events. So, any scenario based on catastrophism must include a very much larger number of small and large catastrophes than is allowed by the creationist model. Therefore, the general argument concerning catastrophism is a non-argument. Creationists claim that geology says that there should be no catastrophes. Creationists find some catastrophes and geologists find many — far more than suggested by the creationist model. I suspect that the problem results from a basic misunderstanding of geology as it is now practiced. The misunderstanding has been caused in part by the geologists themselves: the nineteenth century idea of uniformitarianism and gradualism still exists in popular treatments of geology, some museum exhibits, and in lower-level textbooks. It is even still taught in secondary school classrooms and one can hardly blame the creationists for having the idea that the conventional wisdom in geology is still a noncatastrophic one.

Relative time scales. The charge that the construction of the geologic scale involves circularity has a certain amount of validity. It is true that we date fossils on the basis of our experience with the temporal distribution of the same fossils elsewhere. If one finds a totally new fossil on a roadside, it is impossible to place it in the geologic time scale because it is not in association with rocks or fossils of known age. Thus, the procedure is far from ideal and the geologic ranges of fossils are constantly being revised (usually extended) as new occurrences are found. In spite of this problem, the system does work! The best evidence for this is that the mineral and petroleum industries around the world depend upon the use of fossils in dating. If an oil company learns that petroleum is found in buried reefs of Silurian age, for example, its geologists search for reefs of Silurian age elsewhere. It has been shown over and over again that by following this strategy, more petroleum will be found than if drilling is done on a random basis. I think it quite unlikely that the major mineral and petroleum companies of the world could be fooled.

There is another important element of this argument: the use of fossils in geologic dating is in no way dependent upon biological theories of evolution. The best evidence for this is that the geologic column as we know it was quite fully developed by about 1815, nearly half a century before Darwin published *The Origin of Species*. In other words, the geologic chronology was developed on the basis of fossils before we had any Darwinian theory and it was developed by people who subscribed largely to a creationist view of life. So, geologists using a creationist paradigm developed the geologic column and only later was evolutionary theory added as a means of understanding or interpreting the sequence of fossils found in the rocks. It is in this context that I noted earlier that fossils would work just as well in geologic chronology if they were only funny marks on rocks.

The idea that geologists date a rock by the stage of evolution of its fossils is so deeply ingrained in creationist thought that it needs more discussion. In describing how the geologic column was developed, Boardman, *et al.*, (1973, p. 33) wrote: "... the standard column was developed on the basis of the assumption of evolution. The fossils of 'early' ages are characterized by simplicity, of 'later' ages by complexity, because evolution must theoretically have proceeded generally in this manner." Similarly, Wysong (1976, p. 353) wrote: "... fossils are gathered from around the world... and assembled in a progressive order from simple to complex on a chart." Nothing could be farther from the truth.

I have already noted that the geologic column was constructed before Darwin but there are other

problems with the quotations just given. The method described by Boardman and Wysong would not work even if it were tried. To be sure, the oldest fossils known are of rather simple, procaryotic organisms (in which the nucleus is not separated from the cytoplasm by a nuclear membrane) and younger rocks contain more complex forms (multicellular, eucaryotic organisms—*i.e.*, those with true nuclei), but there is no recognizable trend toward increased complexity that is clear enough to use for dating purposes. This is in part because complexity is so difficult to measure: Is an insect more or less complex than a starfish? This is an "apples and oranges" problem which defies a rigorous metric. Even where the fossil record of a coherent group of organisms can be traced for long periods of time, increasing complexity through time is elusive at best. (This is one of the interesting aspects of evolution: the process is not clearly directional.) Also, for the creationists' view of the way geologic dating works to be true, "simple" organisms would have to go extinct to make way for "complex" organisms so that the fossils in a given rock would give a clear signal. In fact, many primitive procaryotes (bacteria, blue-green algae, etc.) are still living today—apparently quite happily. For this reason alone, stage of evolution could not be used to build a geologic time scale.

The whole problem is made more difficult by the fact that a surprising number of geologists with specialties other than paleontology share the same misconceptions. Wysong (1976, pp. 352-353) takes obvious pleasure in quoting W.M. Elsasser in the *Encyclopaedia Britannica* (1973) as saying: "...the geological method presumes the existence in these periods of living beings of gradually increasing complexity." Professor Elsasser is an excellent geophysicist but his expertise in fields distant from geophysics cannot be expected to be optimal. The creationists (and probably Professor Elsasser) come by their misunderstanding honestly, at least in part. Many teachers and textbook writers, especially in the late nineteenth and early twentieth centuries, have been so carried away by the elegance of the Darwinian model that they have ascribed powers to it that do not exist. It would be a fine thing if we could use some abstract estimate of stage of evolution to date rocks—but we cannot!

The most significant finding of radiometric dating, of course, is that the Earth is extremely old, perhaps 4.5 billion years old, and that life on Earth is almost as old. This is in direct conflict with the 10,000-year-old Earth of scientific creationism. Although there could be some error in radiometric dating (and probably is) it is inconceivable, to me at least, that the error could be anything approaching the difference between billions of years and thousands of years.

Darwinian predictions. Darwin predicted that the fossil record should show a reasonably smooth continuum of ancestor-descendant pairs with a satisfactory number of intermediates between major groups. Darwin even went so far as to say that if this were not found in

Rooted tree trunk 7½ feet tall found in an upright position in a coal mine at Aldeson, Oklahoma. The fossil is a clear indication of rapid burial and this sort of preservation is surprisingly common in the geologic record. Comparably sudden burial today is caused by local floods and landslides, yet the creationists use such cases in the rock record as evidence for the Deluge.

the fossil record, his general theory of evolution would be in serious jeopardy. Such smooth transitions were not found in Darwin's time and he explained this in part on the basis of an incomplete geologic record and in part on the lack of study of that record. We are now more than a hundred years after Darwin and the situation is little changed. Since Darwin, a tremendous expansion of paleontological knowledge has taken place and we know much more about the fossil record than we did but the basic situation is not very much different. We actually may have fewer examples of smooth transition than we had in Darwin's time because some of the old examples have turned out to be invalid when studied in more detail. To be sure, some new intermediates or transitional forms have been found, particularly among land vertebrates. But if Darwin were writing today he would probably still have to cite a disturbing lack of missing links or transitional forms between the major groups of organisms.

An interesting irony in this whole business is that the creationists accept as fact the mistaken notion that the geologic record shows a progression from simple to complex organisms. Faced with the problem of reconciling this presumed sequence with rapid deposition by the Flood, the creationists develop painful explanations of the sequence: large mammals floated to the surface of the Flood sea, complex (and therefore more mobile and intelligent) animals were able to escape to higher ground, and so on. So, the creationists have fit essentially false information into their model—something that would have been quite unnecessary had they read the geological literature more carefully.

Absolute dating. The use of radioactive isotopes in geologic dating has many problems. The methods are inexact and contain many sources of error. In order for the system to work the parent isotope must enter the rock in the absence of any of its daughter products and also, the accumulation of daughter products must be contained in a closed system so there is no leakage of daughter products out of the rock nor migration of indistinguishable isotopes into the rock after it is formed. Furthermore, the half-life of the radioactive isotope must be well known. The last assumption is apparently on firm ground but the others are always subject to problems and errors. This means that a series of dates run on a single rock may produce quite different results, either because of leakage or contamination or because different isotopes record different events in the geologic history of the rock.

Of all the methods, probably carbon 14 is the least dependable and yet it is the most interesting to many people because it is applied to the most recent part of geologic history. In spite of all the difficulties, however, radiometric methods do work well statistically; that is, there are enough concordant dates that the method is successful in dating rocks. One of the best evidences of this is the fact that the relative ages of rocks based on fossils correlate extremely well with the absolute ages of the same rocks based on radiometric methods. The correlation is excellent even though the two methods are as nearly independent as any two methods of measuring time could be.

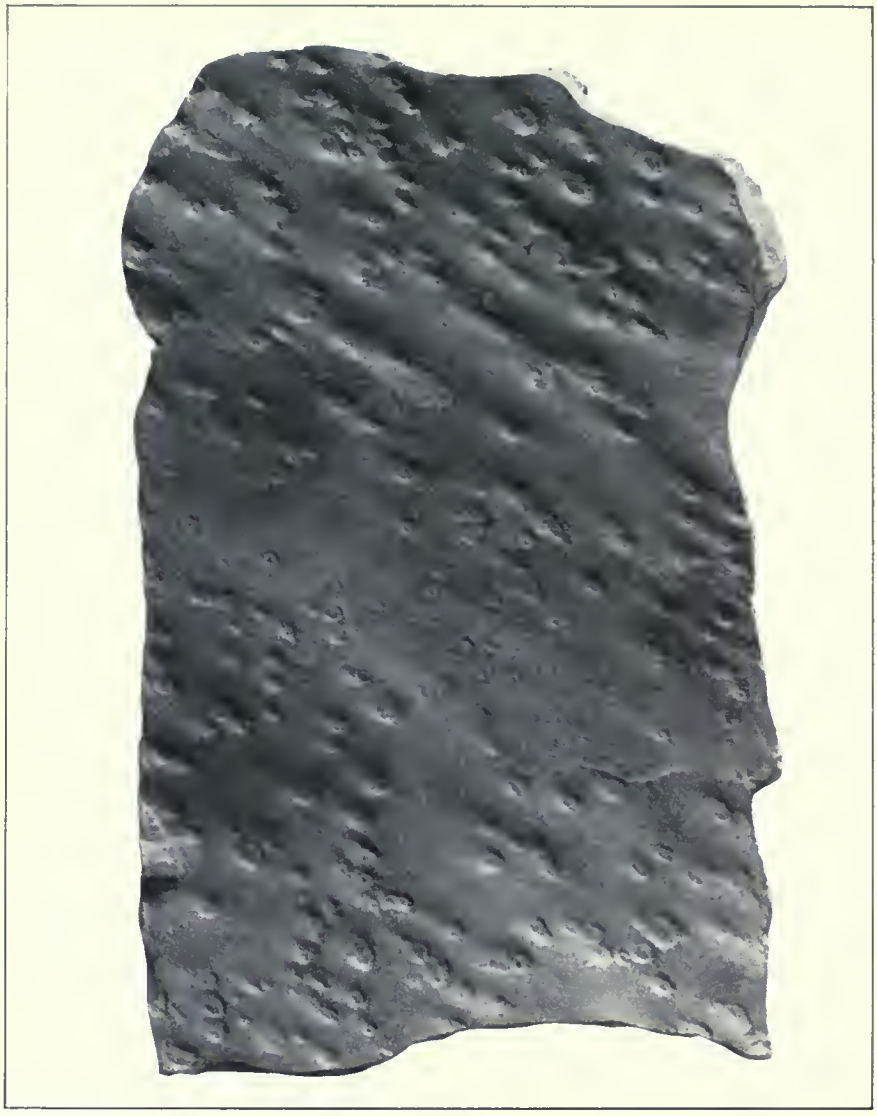
How does the evolutionist explain the lack of intermediates? I see three principal areas of explanation, all of which probably operate to some degree. The first of these is a simple artifact of our taxonomic system of classification. The practicing paleontologist is obliged to place any newly found fossil in the linnean system of taxonomy. Thus, if one finds a birdlike reptile or a reptilelike bird (such as *Archaeopteryx*), there is no procedure in the taxonomic system for labeling and classifying this as an intermediate between two classes, Aves and Reptilia. Rather, the practicing paleontologist must make a decision to place his fossil in one category or the other. The impossibility of officially recognizing transitional forms produces an artificial dichotomy between biologic groups. It is conventional to classify *Archaeopteryx* as a bird. I have no doubt, however, that if it were permissible under the rules of taxonomy to put *Archaeopteryx* in some sort of category intermediate between birds and reptiles that we would indeed do that. Thus, because of the nature of classification, there appear to be many fewer intermediates than probably exist.

In this context, it should be noted that creationists occasionally make the argument that the Darwinian model should predict a complete absence of distinct kinds of organisms. Boardman, *et al.*, (1973, p. 68) put it this way: "If all organisms have actually descended by evolution from common ancestors, it seems inexplicable that there should be any distinct categories of organisms at all. One would certainly expect that nature would instead exhibit a continual series of organisms, with each grading into the other so imperceptibly that any kind of classification system would be impossible."

This, unfortunately, shows a lack of understanding of the separation of genetic systems through reproductive isolation. There is little or no gene flow between species because they do not normally interbreed. Thus, each species is able to evolve on a course independent of all others and there is no opportunity for blending once speciation has taken place. Given time,

and perhaps subsequent speciation events, organisms become distinct. By the same reasoning, major groups such as molluscs and arthropods become increasingly distinct and separated by anatomical gaps. So, the presence of distinct kinds of organisms (especially when viewed at an instant in time) is a reasonable prediction of the evolutionary model. Because the creationist model also predicts distinct kinds (Gish, 1978), their mere presence cannot be a basis for argument between the two viewpoints. The only argument is whether the historical record of fossils should show more transitions between the distinct kinds than it does.

A second line of explanation for the underrepresentation of intermediates is the same one that Darwin used, namely that the fossil record is incomplete. We have as fossils a tiny fraction of the species that have existed. There are many ways of documenting this, but one is simply to look at the comparative numbers of extinct and living species. There are something like two million species known to be living today. We know that the average duration of a species is short relative to the total span of geologic time. Therefore, there must have been turnover in species composition of the earth many times since the beginning of the fossil record. If we had even reasonably good fossil preservation, the number of known fossil species should thus be some large multiple of the number of species living today. Yet only about a quarter of a million fossil species have been found. This can only lead to the conclusion that the odds against fossilization are so high that we are seeing just a tiny fragment of past life. Also, along the general idea of catastrophism, the fossils that we do see depend largely upon occasional or unusual physical and biological events and therefore the record is not a uniform or random sampling of life of the past.



Raindrop impressions preserved in a sedimentary rock. Creationists use such specimens as evidence of instantaneous and catastrophic burial of the land surface. In fact, the conditions for such preservation are commonly observed today, especially in desert situations where soft mud with rain prints is baked hard by the sun.

Under these circumstances, finding transitional forms (or any other particular form) is unlikely and it is thus not surprising that our record appears to be quite uneven and jerky. In addition, most major groups of organisms originated quite early in the geological record: in that part which is especially poor and where intermediate forms would be even less likely to be found. In this context, it is not surprising that our best intermediate or transitional forms are among land vertebrates, which evolved rather late in geologic time.

A third general explanation for the relative lack of intermediates is that transitional forms constitute very short intervals of geologic time if, as many evolutionary theorists now believe, the change from one major type to another occurs rather rapidly (the punctuated

equilibrium model of Eldredge and Gould, 1972). This simply lessens the probability of finding intermediates.

With these considerations in mind, one can argue that the fossil record is compatible with the predictions of evolutionary theory.

Could The Evolutionists Be Wrong?

It would be folly for evolutionists to claim that they have a complete and accurate understanding of the history of life and of the processes that produced that history. Too many major paradigms in science have been overturned for any such absolute statement of confidence to be wise. We should consider alternatives and we should consider the possibility that we might be wrong in at least some parts of the basic framework of evolutionary thinking. And this consideration of alternatives is, in fact, going on in the 1980s with challenges from within evolutionary biology itself to the neo-Darwinian model as it is applied to macroevolution (Lewin, 1980).

There are some basic aspects of evolution, however, that are so close to being simple observation and measurement that evolutionists can claim to be right. In particular, geologic dating (both relative and absolute) is on extremely firm ground. To challenge the basic chronology of life forms would be like claiming that the Sun is only 10,000 miles from the Earth or that the Earth is flat. In effect, we can "see" the geologic time scale! If organic evolution is defined as change in the biological makeup of life on Earth over time then we certainly do have evolution and can "see" the fossil record of that evolution.

The problem of deducing the mechanisms of evolution is quite a different matter. We are confident that the process of natural selection works at the population level and there is no argument about this between the evolutionists and the creationists. But we are not sure whether we can extrapolate this process of *microevolution* to explain the larger scale events of *macroevolution*. Even if it turns out that the classical Darwinian model does not explain some aspects of evolution, we will not be obliged to shift to a creation model. The literature of evolutionary biology and paleobiology contains a host of alternative *biological* models and these are being evaluated and tested in many separate research projects. Thus, the scientific creationists are totally wrong in their so-called two model approach: the claim that if the Darwinian model is discredited, the only alternative is the creation model. □

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Take a Guided Walk Through Time!

How would you like to take a guided walk through time? The opportunity can be yours when Field Museum and the Chicago Architecture Foundation join together to offer two-hour guided architectural walks through Field Museum. These walking tours will be held at 1:00 p.m. on the following Sundays: March 6, March 20, April 3, and April 17.

Cost of the tour is $5.00 for members (Field Museum or Chicago Architecture Foundation) and $8.00 for nonmembers. Reservations must be made with Betsy Kittle at the Chicago Architecture Foundation, 782-1776.

As the tours are limited to 25 persons, please call early to reserve your place. We are sure that even the most seasoned traveler will find these walks a delight!

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Costa Rica

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Kenya

September 1983

Audrey Faden

Stanton R. Cook, courtesy *Chicago Tribune*

China

October 7 – 28

For detailed information on any tour please call or write the Field Museum Tours office (322-8862).

OUR ENVIRONMENT

Sale of Confiscated Wildlife Products Yields $250,000 for U.S. Treasury

The sale of a 10-year backlog of confiscated wildlife products has generated an estimated $250,000 in bids from people across the country. Proceeds from the sale, less administrative costs, will be deposited in the U.S. Treasury. The products have been stored at government expense since their involvement in violations of various federal and state wildlife conservation laws.

"It's unfortunate that so many people had to learn about these laws the hard way," commented a U.S. Fish and Wildlife official. "Many of the laws have been on the books for years. We hope that everyone, especially those in the travel and fashion industries, will make a special effort to learn about them so that they can be spared the expense and embarrassment of having their shipments confiscated when they arrive illegally in this country."

About 28,000 bids were placed by 574 people in the largest sale of its kind of 380 lots of ivory, reptile leather products, fur coats, and assorted curios made from wildlife. Several people bid on the entire collection, while as many as 150 bid on many of the individual lots. The highest bid, and also a tie bid broken by the flip of a coin, was $14,753.30 for 94 fur coats sold as one lot. The second high bid of $14,144 was for 640 pieces of black coral jewelry. Other winning bids were $357.99 for an armadillo guitar with broken strings; $909 for nine armadillo handbags; $552.60 for 36 elephant hide beer mugs; $1,928.88 for a 53.8-pound elephant tusk; $180 for four stuffed caimans; $200 for a stuffed coatimundi; $500 for a large elephant foot stand; $688 for four elephant foot ice buckets; $220 for 44 hollow ostrich eggs; $1,257 for a lion skin; $1,678 for a mink coat; and $310 for 72 pairs of ladies' python shoes.

The Fish and Wildlife Service has a much greater volume of more restricted products that cannot be sold, such as endangered species, marine mammal, and migratory bird specimens and products. They are being made available as loans or donations to zoos, museums, universities, research institutions, or government agencies for public display or educational purposes.

Raccoon Dog Imports Prohibited

The U.S. Fish and Wildlife Service has listed the raccoon dog *(Nyctereutes procyonoides)* as an injurious animal under the Lacey Act in order to limit its importation into the United States. The injurious animal list includes species such as the mongoose, the fruit bat, Indian wild dog, and others which the Secretary of the Interior has determined are harmful to the environment.

Though actually Asiatic canids, raccoon dogs resemble the American raccoon and have many raccoonlike habits, including a wide selection of foods ranging from bird eggs and small mammals to carrion and garbage. Between 1929 and 1955, Russian wildlife agents captured nearly 9,000 raccoon dogs from their natural Eastern Siberian range and released them as furbearers in central and western parts of the Soviet Union. From these stocks, the animals have become widely established in Europe from Scandinavia to Greece.

Their dense, yellowish, black-tipped pelage is used by furriers for coat trim and parka linings. Two American fur farms already raise raccoon dogs, selling their pelts to the fur trade for an average of about $80 each. Although none of the captive animals is known to have escaped at this time, it is feared that if more fur farms were allowed to raise the animals, accidental releases would eventually occur as has already happened with nutria, gerbils, monk parakeets, walking catfish, and other exotic animals. The danger is that the diminutive but adaptable dogs would move into ecological niches already occupied by native American furbearers. Their ability to live in many different climates and forage on a wide variety of foods put them at an advantage over native furbearers. Bobcats, lynxes, foxes, badgers, opossums, skunks, and raccoons might suffer if raccoon dogs take hold. The alien animals could also do serious damage to ground nesters such as ducks, geese, and upland game birds.

Raccoon dog on view in Hall 15.

Like its namesake, the raccoon dog weighs from 10 to 17 pounds, has dense, grizzled fur, black cheek spots, small feet, and a full tail. It is also nocturnal. Unlike the raccoon, which usually makes its den in a hollow tree, the raccoon dog digs its own burrow. And like a bear it fattens up in the fall and sleeps through the coldest months. It is, in fact, the only known winter sleeper of the world's canids.

Listing raccoon dogs as injurious animals prohibits both the importation and interstate shipment of live specimens except under permit for scientific, medical, educational, or zoological purposes. The Canadian Wildlife Service placed the raccoon dog on its Import Control List in October 1981.

MISS MARITA MAXEY
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FIELD MUSEUM OF NATURAL HISTORY BULLETIN

April 1983

A Celebration of Birds

Louis Agassiz Fuertes and His Art

April 30 to June 26

Field Museum of Natural History Bulletin

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ERRATUM

In the March 1983 *Bulletin*, on pages 22 and 23, a block of copy in David M. Raup's article, "Geology and Creationism," was imposed out of sequence. Paragraphs 2 and 3 of the third column on page 22 should directly follow paragraph 2, column 2, on page 23. The editor inadvertently transposed the copy during final production and offers his apologies to the author and to readers.

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COVER

Painting of gray-headed kingfisher done in Abyssinia (Ethiopia) in 1927 by Louis Agassiz Fuertes. Painting is among several dozen by Fuertes in the Field Museum collection. Exhibition of Fuertes paintings, organized by the Academy of Natural Sciences, Philadelphia, opens in Hall 9 on April 30. See page 5.

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Events

Special Events

"The Queen's Garden"
with Dr. John Paling
Sunday, April 17
2:00 pm, West Entrance

In the center of London's swirling traffic there is a sanctuary—a green oasis which has intrigued thousands of Londoners and visitors alike. A landmark in history, where some 350 years ago James I planted a mulberry tree which still grows, still bears fruit . . . not quite 40 acres, yet more precious, perhaps, than any crown jewel—the Queen's Garden at Buckingham Palace.

Dr. John Paling was an Oxford lecturer when he became interested in developing photo techniques that would enable lay viewers to share the incredible sights of nature previously known only to scientists. Several Oxford fellows who shared this ambition organized themselves into Oxford Scientific Films, Ltd., seeking new ways to record on film the wonders of nature. Before long imaginative scientists-turned-filmmakers were described by the *London Times* as . . . "probably the most technically advanced biological filming unit in the world."

Join us as Dr. John Paling brings to us one hour of sheer magic and exploration. Share the incredible sights of nature with us. This program is supported in part by the Ray A. Kroc Environmental Fund and is recommended for adults and children. Please use the coupon below for tickets.

Members: $3.00; nonmembers: $5.00

"Maritime Peoples of the Arctic and Northwest Coast"
First Anniversary Celebration
Sunday, April 24 12:00noon-3:30pm

Join us for a special day as we celebrate the first anniversary of the opening of Hall 10. Featured activities include: "Joe David—Spirit of the Mask"; a film about Northwest Coast carver, Joe David; "Art of the Northwest Coast," a slide lecture on the designs and motifs of these people of totems; a tour on Kwakiutl Winter Ceremonies; and for the children, a chance to draw their own six-foot totem pole. Consult the *Weekend Passport* when you arrive for more information. See page 15 for a complete schedule of programs.

Highlights

"A Calendar of Gems" Family Feature
Saturday and Sunday, April 16 and 17
1:00pm, Hall of Gems, 2nd Floor

Certain minerals enjoy special status for their color, brilliancy, or rarity. Many have been held sacred and are surrounded by traditions and legends. Gems have been assigned to the months of the year and these birthstones, many people believe, bring luck to the wearer and influence one's personality by enhancing important traits. Learn how gemstones are formed, the symbolism behind your birthstone, then seek out your "special mineral" in the Hall of Gems.

Edward E. Ayer Film Lectures
Saturdays at 1:30pm, James Simpson Theatre

April 2	"Hawaii," with Frank Nichols
April 9	"Vancouver," with Tom Sterling
April 16	"The Naturalist Afield Pt. 2," with Steve Maslowski
April 23	"The Three Rivieras," with Frank Carney
April 30	"Mighty Mississippi," with Willis Butler

Weekend Programs

Each Saturday and Sunday you are invited to explore the world of natural history at Field Museum. Free discovery tours, demonstrations, and films related to exhibits are designed for families and adults. Check the *Weekend Passport* upon arrival for schedules and locations. These programs are partially supported by an Illinois Arts Council grant.

April 2	1:00pm	Hopi Ceremonial Life, tour
April 9	11:30am	Ancient Egypt, tour
April 10	1:30pm	Eskimos: Hunter of the North, tour
April 16	2:00pm	Malvina Hoffman, film/slide lecture
April 17, 23	2:30pm	Treasures of the Totem Forest, tour
April 23	2:00pm	Masks, Boxes, and Bowls, slide lecture
April 30	2:30pm	Chinese Ceramic Traditions, tour

Exhibit Opening

"A Celebration of Birds: Louis Agassiz Fuertes and His Art"
April 30 to June 26, Hall 9

Louis Agassiz Fuertes is considered by many to be America's greatest illustrator of birds. This exhibit, featuring more than 125 works, illustrates his superb draftsmanship, innovative compositions, and sensitive use of color and light. A New York resident, Fuertes travelled widely in search of birds, visiting five continents during the late 19th and early 20th centuries. Also on view will be a rare copy of Audubon's *The Birds of America*, paintings by Rockwell Kent, Abbott Thayer, and others.

Coming Events

Kaze-no-ko (Children of the Wind)
presented by The Asia Society of New York
Sunday, May 8, 2:00pm
James Simpson Theatre

Join us as Kaze-no-ko, a team of Japanese actors/mimes, bring an enchanting view of the world past and present. For advance ticket purchase use coupon below.

Members: $6.00; nonmembers: $8.00

Courses for Adults
Beginning the week of April 11.
Call 322-8855 for course and registration information.

Kroc Environmental Field Trips
Register now for May and June weekend field trips.
Call 322-8855 for more information.

Registration

Please complete coupon for your program selection and any other special events. Complete all requested information on the application and include section number where appropriate. If your request is received less than one week before program, tickets will be held in your name at West Entrance box office until one-half hour before event. Please make checks payable to Field Museum. Tickets will be mailed on receipt of check. Refunds will be made only if program is sold out

Program Title	Member Tickets #Requested	Nonmember Tickets #Requested	Total Tickets #Requested	Amount Enclosed
			Total	

Name

Street

City State Zip

Telephone Daytime Evening

For Office Use:

Date Received **Date Returned**

Return complete ticket application with a self-addresed stamped envelope to:

Public Programs: Department of Education
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605-2497

Have you enclosed your self-addressed stamped envelope?

NEW EXHIBIT:

A Celebration of Birds

Louis Agassiz Fuertes and his Art

April 30-June 26

Hall 9

Fuertes (1874-1927,) was a native of New York state who travelled the world in search of wildlife subjects in the late 19th century and the early years of this century. For some time he has been regarded by many as more talented than Audubon. Nonetheless, this is the first time a full-scale retrospective of his work has been offered. The show will contain field sketches, drawings, and finished paintings from all periods of the artist's life.

While Fuertes' exquisite bird paintings will be the major focus of the exhibit, there will also be representative paintings of mammals and insects made during the artist's expeditions in Central and South America and in Africa. A number of works by natural history painters who influenced or were influenced by Fuertes will also be included, such as Audubon, Ernest Thompson Seton, Allan Brooks, George Miksch Sutton, Courtenay Brandreth and Roger Tory Peterson.

Supplementing the show, during its Chicago visit, will be a group of Fuertes paintings from Field Museum's own collection of his work, which numbers several dozen pieces.

Bateleur
by Fuertes

Organized by the Academy of Natural Sciences, Philadelphia, and circulated by SITES (Smithsonian Institution Traveling Exhibition Service), the exhibition was made possible by the Atlantic Richfield Foundation, the Insurance Company of North America, and the National Endowment for the Arts.

Many of the paintings in the exhibition are also included in the new full-length biography *A Celebration of Birds*, by Robert McCracken Peck. The following account (pages 6-11) of Fuertes' last work in the field, with the Field Museum/Chicago Daily News Abyssinian Expedition in 1926-27, is excerpted from *A Celebration of Birds* and used by permission of Walker & Co.

In the early spring of 1926, Louis Fuertes received a direct and rather startling letter from James E. Baum, a wealthy Chicago writer and sportsman whom he had met while vacationing at a Wyoming ranch the summer before. The letter read, in part, as follows:

Left: *crowned lapwing;* right: *spur-winged lapwing, by Fuertes*

If a man should come to you and ask: What is the strangest country in the world to-day? Where is the bird life the most curious and plentiful? You would unquestionably answer both by one word—Abyssinia.

All right. Now that we have established the desirability of your going there, what do you say to going with me next September?

Baum went on to explain that he was planning to take his family to Europe, spend the summer in France and England, then embark on a three-month hunting trip in Abyssinia (now Ethiopia). While Fuertes was excited by the idea of seeing Africa, he had some doubts about mixing a working expedition of the sort he would have wished with the recreational expedition Baum was proposing.

On a trip to Chicago a few weeks after receipt of the letter, Fuertes went with Baum to discuss the idea with Wilfred Osgood, curator of zoology at the Field Museum of Natural History and a long-time friend of Fuertes. Osgood became interested in the project, and together they devised a plan whereby the expedition could be officially sanctioned—and financed—by the museum. A week later, Baum talked with his friend Walter Strong, editor of the *Chicago Daily News*, to see if the paper would provide partial support of the expedition in exchange for exclusive rights to cover the trip. At the same time, Osgood approached the museum's president, Stanley Field, and its director, David Charles Davies, to discuss how much of the cost the museum would be willing to underwrite. "We've sold our proposition," wrote Osgood to Fuertes a few days later. "In fact, we're oversubscribed and the privilege of backing us was near to becoming a matter of contention between bidders." Before Osgood's letter arrived, however, the bidding was over and the results announced: "EVERYTHING ARRANGED — STOP — NEWS WILL FINANCE WHOLE EXPEDITION TO THE EXTENT OF TWENTY-FIVE THOUSAND. HOORAY — JACK BAUM."

The speed with which the trip had been arranged, and the telegram announcing its final settlement, seemed to Fuertes almost too good to be true. "The actuality has always hitherto seemed somewhat nebulous and third-personal," he wrote to Osgood. "Now it looms and it behooves me to assail my job with a purposeful finality it isn't used to!"

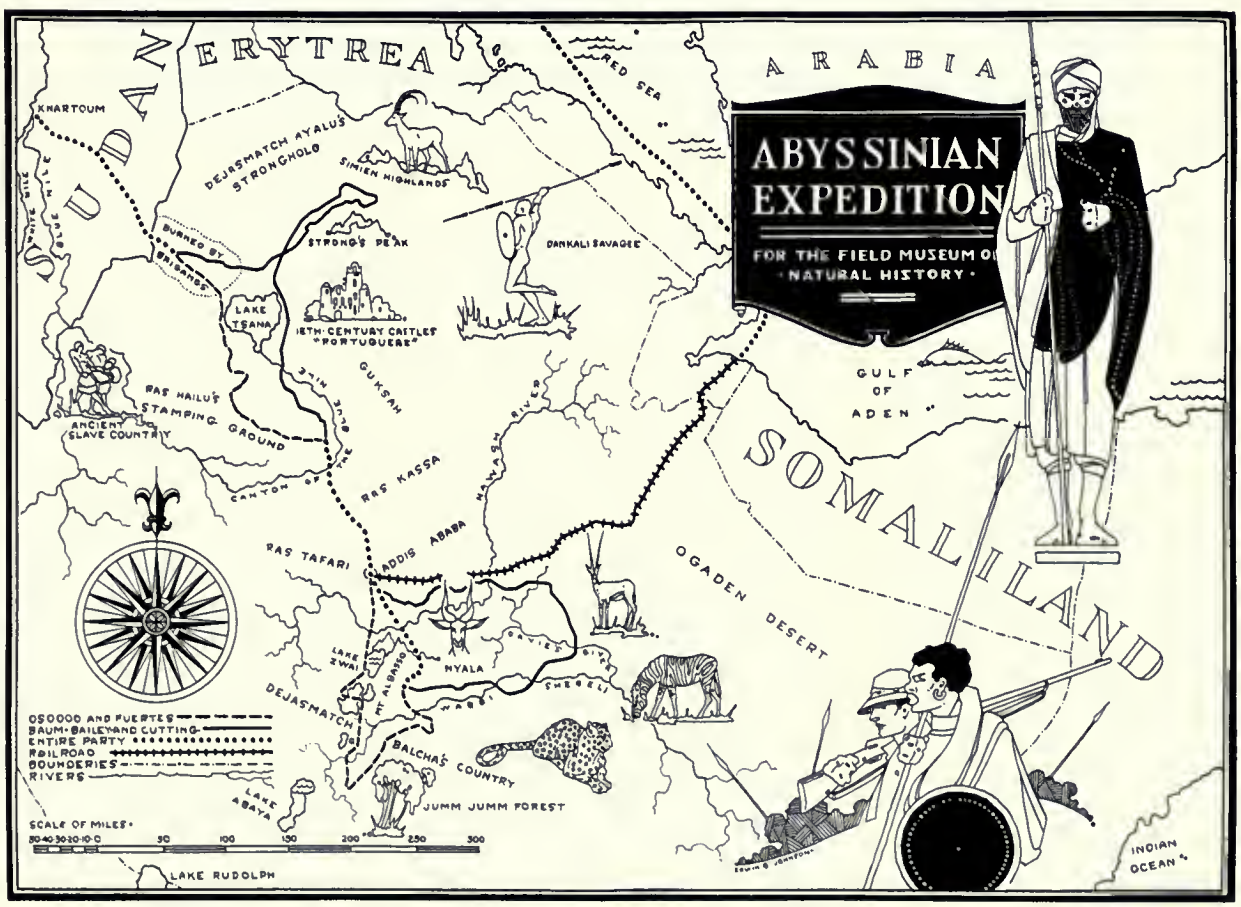
The Field Museum/Chicago Daily News Abyssinian Expedition traveled by boat from Marseilles, through the Suez Canal and down the Red Sea, arriving in Djibouti, French Somaliland, on October 4, 1926. From there, the group traveled three days by train to Addis Ababa, the capital of Abyssinia, 500 miles to the west. In addition to Baum, Fuertes, and Osgood, the party included C. Suydam Cutting — a patron of the Field Museum who had volunteered for the expedition—and Alfred M. Bailey, a young zoologist who had recently joined the museum staff.

"There is no describing Addis," wrote Fuertes a day after arriving in the capital, "so I'll try! Crowded aimless streets — full of people of all sorts, cattle, sheep, goats, camels, horses, burros, and more of the same." To Baum it was a "forest town" surrounded by dense strands of eucalyptus and footpaths winding "everywhere through the woods without apparent rime or reason." And to Bailey, Addis Ababa was "a primitive town, a page turned back to the days of the Arabian Knights."

Taking up residence in the commodious Imperial Hotel, the party spend several weeks purchasing mules, hiring bearers, and obtaining the necessary travel permits. This last important task required an audience with Ras Tafari (Haile Selassie), emperor of Ethiopia. The thirty-four-year-old monarch, whose titles also included Prince Regent, King of Kings, and Conquering Lion of Judah, received the Americans with cordial dignity just a few days after their arrival. "I suppose we were there half an hour," recalled Fuertes:

> After outlining the plans roughly, O[sgood] explained the purposes of our work and presented the two books of photos of the museum and Chicago, and I gave my two books [specially bound copies of the *National Geographic Book of Birds and Book of Animals* illustrated by Fuertes] with the request that one be passed on to the Empress. O said, 'These are not expensive gifts; merely evidences of our gratitude, and an explication of the nature of our work.' Ras Tafari then smiled his nicest (which is very nice) and said, 'The thought ahead is worth a great price.'...Then, after all business was concluded, the Ras said, 'I will see you again before you leave,' and soon after, we came away. We felt that if we had impressed him as strongly as he did us we should have no trouble.

As Fuertes had hoped, the positive impressions were mutual, and Ras Tafari provided the travel documents necessary to guarantee safe passage for the expedition members to all parts of the country. Before their departure from Addis Ababa, the Ras invited the Americans to an elaborate dinner party with bountiful and delicious food, solid gold dinner service, cut glass goblets, and china bearing the Abyssinian royal crest. Afterwards, Osgood showed movies of life in America, and discussed the purpose and contents of the Field



Museum. "'Why, these animals stand exactly as if they were alive,'" exclaimed the Ras when he saw pictures of the museum's African dioramas. "'I don't understand how stuffed skins can be made to appear so lifelike. Now I can see why people are interested in museums. This is a great work you are doing, educational and instructive and I shall be glad to give you every assistance.'"

While Ras Tafari's support was the most critical for the expedition's success, offers of assistance from other sources were also accepted with enthusiasm. When a European resident of the capital, Colonel D.A. Sanford, offered the use of his ranch on the rim of the Muger River, thirty miles north of Addis Ababa, Osgood suggested that Fuertes and Bailey accept the invitation.

Traveling first by car, then on horseback, the two men observed an abundance of bird life along the way. "This is the highlight of my ornithological career," exclaimed Fuertes at one point during the trip. "Birds everywhere and every damned one is new to me."

Fuertes' productivity in Abyssinia, both in specimen preparation and painting, is quite remarkable, considering that all of his luggage was lost in transit. In a letter describing the bad luck, he admitted, "I am handicapped by having to use untried and unaccustomed tools, inadequate clothes for the uplands where it gets really cold, no painting or even drawing things at all, and the loss of a whole trunkful of conveniences —drying trays, skinning tools, etc., that I had carefully planned ....But I can get along," he declared, "and it would take a lot more than that to throw me." Borrowing clothing, guns, and skinning supplies from other members of the expedition, and purchasing a small watercolor set in Addis before leaving for the ranch, the ingenious naturalist proceeded through the rest of his Abyssinian stay undaunted.

Colonel Sanford's ranch proved to be almost as exotic as the bird life. Perched on the rim of the Muger Canyon, it overlooked some of the most spectacular scenery in East Africa. "Roses and snapdragons bloomed profusely, and the view from the front porch across the rose-filled garden and the deep canyon beyond was one we were not likely to forget," recalled Bailey. Since the two men had the ranch to themselves, with a full staff of servants to support them, their work was not inhibited by social obligations. Rising at dawn, each would spend the morning collecting—Fuertes, birds; and Bailey, small mammals. By 9:30 or 10:00, they would return to the house for a day's worth of specimen preparation. "We sit on the porch skinning," wrote Fuertes, "and toss the bodies of birds and mice into the air; none has yet hit ground, for a dozen graceful kites sailing around nip them on the fly as daintily as can be."

Fuertes and Bailey were sorry to leave the ranch after only six days, but when Osgood wrote that preparations for the expedition's southern trip to Arusi had been completed and the rest of the party would soon be ready to depart, they had little choice but to return to Addis Ababa. Each had prepared over eighty specimens for the museum during their stay at the Muger Canyon.

On October 30, 1926, almost a month after its arrival in Addis Ababa, the expedition was ready to leave for Arusi. "It was like setting off to the wars this afternoon," wrote Jack Baum in his first syndicated column about the expedition:

> A string of thirty-six pack mules makes an imposing outfit. Add to that, nine mounted men, naghdis, personal boys, two cooks and two interpreters. Those men must ride. They are not to be confused with the twenty common packers or mulleteers who walk....Strung out along the line carrying their old-style French army guns, model 1870, were ten sabanias, or guards ...with heavy cartridge belts gleaming in the bright sunlight....We forded a stream, climbed a long sloping hill and saw before us Mount Zuquala, rising like a gigantic pyramid to the south. The broad African landscape spread out at our feet with its thornbush, its flat-topped acacia trees, its shimmering haze, its illimitable distances, its broad plains. That trying six months of preparation was over. The trip had begun.

By the time they returned to Addis Ababa two months later, the expedition had succeeded in one of its missions: obtaining specimens of the beautiful horned nyala for a habitat group in the Field Museum. Fuertes and Osgood, who had split off from the rest of the group, had collected over an extensive area to the south. Fuertes reported in a letter to his wife that during the course of the trip he had "painted 50 or 60 field studies, many quite elaborate, and collected and preserved 559 birds...in over 40 different camps." Osgood, who had been collecting with Fuertes, returned with nearly 500 mammal specimens, including a number of large antelope.

At their reunion in the capital city in late January, the two exploring parties had many tales of adventure to relate. Encounters with wandering bands of brigand "shiftas" and a near-fatal leopard attack had added excitement to the Baum, Bailey, and Cutting party's experiences. Osgood and Fuertes found their adventures somewhat less dangerous, except for one occasion when Fuertes, separated from the main caravan, was hailed and held "social prisoner" by a local chieftain for more than two hours. "We had, of course, many picturesque experiences," recounted Fuertes, "my topnotcher, perhaps, being a late afternoon

swim in Lake Sh'ala with the hippopotami coming up to huffle and blow every few minutes, often quite nearby. They were not at all alarmed, and we had a very nice swim together!"

During their second stay in Addis Ababa, the Field Museum party was again entertained by Haile Selassie, who took a keen interest in their travels and scientific work. When Fuertes showed him some of the bird studies he had made in the field, wrote Jack Baum, "The Ras was much impressed, especially by one of a guinea fowl, so much so, in fact, that he ordered an attendant to bring in a live guinea fowl. He compared the live bird to the picture and gasped at the resemblance...." Fuertes asked the Ras to choose one of the studies he liked, to be worked up into a finished painting by which he could remember the expedition. The Ras chose a trogon.

After replenishing supplies in Addis Ababa and bidding farewell to the emperor, the expedition headed north toward the mountainous province of Gojam. They camped on the 10,000-foot summit of Mount Entoto, then at Colonel Sanford's ranch on the Muger River, where Fuertes and Bailey had made their first Abyssinian collections.

After a study of the canyon bottom, not previously visited, the caravan traveled further north and entered a large plateau, an agricultural area "tilled by strong-looking Gallas who drove oxen hitched to plows which were merely crooked sticks." From there, the party descended into the deep chasm of the Abbai River, or Blue Nile, and after an arduous climb up the far side, arrived in Gojam, a province governed by the powerful Ras Hailu. There they were met by a messenger with greetings from the Ras and an invitation to visit in the provincial capital, Bichana. "Our reception by the great chieftain was all that anyone could ask," recalled Bailey:

> Our caravan of approximately a hundred mules crossed a weak bridge over the river without any of the heavily laden animals falling through. We finally came to a high ridge. We climbed the steep hill and were amazed to see an assemblage of half a thousand soldiers sent out to greet us. It was a touch of the Arabian Knights and medieval splendor; the white-clad Abyssianians headed by a dignified chamberlain were drawn up in double file, and a reed-and-trumpet band blew lustily on their instruments—each one capable of playing a single note. We made a triumphant march across the plains, preceded by the band and followed by the throng of soldiers. A large tent had been erected for us. The ground was covered with oriental rugs, and we made ourselves comfortable while lunch was being prepared. Greetings were sent to the Ras, and it was not long before lines of slaves were before our tent bearing gifts of tej (a native mead), beer, chickens and eggs, and an ox to be killed for our men.

African pygmy kingfisher by Fuertes

After several days of feasting and entertainment, and a hunt with the Ras at which a thousand of his followers were in attendance, the party left Bichana.

As before the expedition divided into two groups. Baum, Bailey, and Cutting went north to the Simyen Highlands to collect Abyssinian ibex and other big game. Fuertes and Osgood traveled west of Lake Tsana in search of birds and small mammals.

Along the trail, Fuertes spot-

ted a large snake in the trail ahead of his party. Since few snakes had been collected during the expedition, he drew his revolver and shot the six-foot reptile from the saddle. Then, according to Bailey, he dismounted and "in spite of the horrified protests of the natives, he picked it up. He was careless; the snake was not dead, and it struck, just scraping the skin of his hand." Months later, Osgood wrote from the Field Museum to tell Fuertes that the snake had been identified as a Mamba, probably the most poisonous species in Africa. " Maybe there is a God, after all," wrote Osgood, recalling his friend's close call.

The divided parties met as planned after two months' separation and, traveling together through dangerous brigand country, crossed the Sudanese border and arrived in Khartoum on May 1st. There, Bailey recorded in his journal, the party "stayed at the Grant Hotel, a rambling first-class affair on the banks of the Blue Nile," where they attended to the packing of their specimens. "A carpenter was hired and 22 cases of specimens, etc., were packed."

Narina trogon by Fuertes

Fuertes wrote his son Sumner that the trip had provided "a lot of fun and interest" and had "netted 2,000 birds, 1,400 mammals and 100 scattering specimens—3,500 in all, all first class and of very valuable stuff."

After a week in Khartoum, the expedition steamed up the Nile and, after stops in Cairo and Alexandria, crossed the Mediterranean, which Bailey and the others found "delightfully cool...in contrast to the 115 degrees we had experienced in the Sudan."

Meeting his wife and daughter in London, Fuertes returned to the United States with them in May. As their boat headed for New York, another American was making history in the air above them. Though they did not see his plane, the Fuertes delighted in the news of Charles Lindbergh's successful trans-Atlantic flight.

The Abyssinian trip, Fuertes' longest and most distant, was also his last, for less than three months after his return he suffered the fatal automobile accident that left his friends and admirers stunned and saddened. In a *Bird-Lore* obituary, Frank Chapman commented on Fuertes' qualities as a field naturalist and on his value as a friend:

> Fuertes' value in the field was not restricted to his cheerful comradeship and his skill as an artist. He was a keen, tireless, and persistent collector and a stimulating scientific associate. In the Canadian Rockies it was Fuertes who discovered the nests of Ptarmigan and Pipit that appear in the American

Museum's Arctic-Alpine Group. In Mexico it was Fuertes who in the field recognized as new the Oriole subsequently named for him, and in the dense subtropical forests of the Colombian Andes he secured specimens and identified the notes of birds which no other member of our party saw.

Nor did he confine his activities to science and art, to preserving birds as well as to painting them. Always he did more than his share of the work incident to travel and life in the open. He was an experienced woodsman, a good packer, a capital cook, a master hand with tools, who could mend anything, and in adversity and sickness no mother could have been more tender.

So one might continue to enumerate the qualities for which Fuertes was beloved and still fail to convey a realization of the rare personal charm which made his mere presence a source of joyous possibilities. To those who lives were enriched by his friendship the world will never be the same again.

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Above: *Fuertes with lammergeier, a type of vulture.* Below: *Fuertes visits with Fitaurari Adamassu, a local chief in northern Abyssinia.*

A Celebration of Birds

The Life and Art of Louis Agassiz Fuertes

by Robert McCracken Peck; introduction by Roger Tory Peterson

Published for The Academy of Natural Sciences of Philadelphia
Walker and Company, New York

xiii + 178 pages, 49 color plates

$30.00

Now available at Field Museum Stores
10% discount for Members

This exceptionally beautiful study of the life and work of Fuertes may be ordered by mail from the Field Museum Stores. Please make check or money order payable to Field Museum, including $2.00 for postage and handling.

TOURS FOR MEMBERS

Kenya, September 10–28

Kenya

with optional extension
to the Seychelles

September 10–28
price to be announced

There is an aura or mystery surrounding Africa: tropical islands and the coast, endless beaches, snow-capped mountains, jungle primeval, and sun-baked plains. They are all part of East Africa. Only here can one find such diversity. The itinerary includes a daytime stopover in London, overnights at the Nairobi Hilton, Mt. Lodge Tree Hotel, Samburu Game Lodge, Mount Kenya Safari Club, and other 1st class accommodations. An overnight stay in London concludes the trip. A 3-day extension to the Seychelles is an available option. Tour lecturer will be Audrey Faden, former staffer of the National Museum of Kenya, who has led two earlier Field Museum tours to Kenya.

A second option—a safari by camel—is also planned, though not yet confirmed at publication time.

Stanton R Cook, courtesy *Chicago Tribune*

China, October 6–28

Wisconsin's Baraboo Range

May 14–15
$125

Dr. Edward Olsen, curator of mineralogy, will lead you through the Baraboo Range and the hinterland of Devil's Lake, 150 miles from Chicago. The range is a remnant of an ancient formation of mountains, standing out above the younger rocks and sediments. It provides the energetic hiker with a fascinating learning opportunity as well as an invigorating outing. Overnight accommodations and meals will be at a nearby motel. Hiking clothes are strongly recommended. The trip is not suitable for children, but younger people interested in natural history are welcome.

Ancient Capitals of China

October 6–28
price to be announced

The unique itinerary of this tour, rarely granted by the Chinese authorities, includes the most significant sites of early Imperial China and will give an opportunity to explore in depth the civilization which characterizes one of the earth's longest-lived societies. At a small additional cost, you may remain longer in Japan at completion of the China tour. Tour leader is Mr. Phillip H. Woodruff, Ph.D. candidate in Chinese history at the University of Chicago. This is Mr. Woodruff's 4th time as a Field Museum China tour leader.

Grand Canyon

May 27–June 5
$1,600

Last call for this exciting adventure, traveling by rubberized motor raft down the Colorado River!

For further information on any tour, please call Dorothy Roder at 322-8862 or write Field Museum Tours.

Devil's Lake—Baraboo Range, May 14–15

TOURS FOR MEMBERS

Costa Rica Tour

William Burger

January 14-27
1984

When one looks at a map of Central America the first impression is that the small countries located there must be very similar to each other. But this is not the case; some have had very different histories and their climates and physiography differ as well. Costa Rica, situated between Nicaragua and Panama has been called the Switzerland of middle America. While it doesn't have snow-capped mountains, the verdant pastures with dairy cattle, cool forested highlands, and the occasional blond youngster do make one think of a central European setting.

Costa Rica is distinguished by a large middle class, a high literacy rate, a strong tradition of democratic government and the lack of an army. (When President Kennedy came to visit they had to borrow cannons from Nicaragua to make up the traditional 21-gun salute.) The friendliness of the people and their strong educational system has made Costa Rica a hospitable country for visitors and scientific researchers. Excellent medical care and attention to clean water and sanitation make it one of the safest countries in the tropics to visit.

While these factors have helped make Costa Rica something of a mecca for research in tropical biology, the principal reason for such work is its very rich flora and fauna. On a flat map Costa Rica has about half the area of Ohio, but the country boasts half as many flowering plants as all of North America north of Mexico, and almost *twice* as many ferns. Eight hundred species of birds have been recorded in Costa Rica, a little over 600 being permanent residents.

How does such a small area pack in so many species? A large part of the answer to this is that Costa Rica is anything but flat; high mountains, deep valleys, active volcanoes, and broad alluvial plains provide a great variety of habitats. The wide range of altitudes (from sea level to 12,000 feet) have superimposed upon them a variety of rainfall patterns, from 36 inches of rain in the seasonally dry northwest to over 150 inches of rain per year in the northeast. The wonderful mix of altitude, rainfall, and topography give Costa Rica a wide array of vegetation types and support the diversity of plants and animals.

In January of 1984 Field Museum will be offering a tour to Costa Rica focusing on the variety of tropical habitats and its rich biota. Cool and misty cloud forests, lowland rain forests, riverine swamp forests and seasonally deciduous forests will be visited. We will also spend time looking at how people have utilized these tropical areas to produce food crops, ornamental plants, and a variety of other crops that cannot be grown in colder climes.

While plans for the tour are ambitious (it will be a "busy" tour more than a leisurely one), we will pace ourselves so as to be able to record our views and impressions on film. Photography of tropical vegetation, ornamental plants, and wildlife will be a major objective. William Burger, chairman of the Museum's Department of Botany, and Tom Economou, a tropical horticulturalist based in Miami, will lead this tour.

A deposit of $50.00 per person will secure a reservation. The price of the tour will be announced in the near future. Itinerary and other information may be obtained by writing or calling the Field Museum Tours office: 322-8862.

FIND OUT HOW MUCH YOU DON'T KNOW ABOUT WILLS. . .

Many false ideas about wills actually cause people to put off or neglect writing their wills. The booklet offered below explains why every adult needs a will, and the sooner the better. Send for your copy now.

But, what if I change my mind?. . .

What if I write my will now while I am still young, then change my mind in five years when my children are older and my financial situation has altered?. . .

Most people do change their minds, several times in fact, as their lives and personal goals change. That is why wills can and should be changed periodically. Some changes can be made with a simple amendment; others may require rewriting.

The booklet offered below has some helpful information about writing or updating your will, and how to include a gift to Field Museum of Natural History after your family's needs are met. Order your free copy today.

Clip and Mail Today!

Planned Giving Office
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605

Please send me my free copy of "37 Things People 'know' About Wills That Aren't Really So."

*Name*_____

*Street*_____

*City*_____ *State*_____ *Zip*_____

You can reach me at:

*Phone (home)*_____

*(business)*_____

FIELD BRIEFS

Spring Systematics Symposium

The sixth annual Spring Systematics Symposium will be held at Field Museum on May 13 and 14. The theme this year is "Extinction." Symposium chairman is Matthew N. Nitecki, curator of fossil invertebrates.

The symposium will include seven lectures, delivered on Saturday, May 14, in James Simpson Theatre. At 9:30am, Walter Alvarez, of the University of California, Berkeley, will speak on "The Impact Theory for the Terminal-Cretaceous Mass Extinction." At 10:15am, Paul S. Martin of the University of Arizona, will speak on "Pleistocene Overkill: A Challenging Model." At 11:00am, Andrew H. Knoll, of Harvard University, will speak on "Extinctions in the Evolutionary History of Vascular Plants." At 1:15pm, Thomas E. Lovejoy of World Wildlife Fund-U.S., will speak on "Ecosystem Decay of Amazon Forest Remnants." At 2:00pm, Jared M. Diamond, of the University of California, Los Angeles, will speak on "Extinctions on Real and Virtual Islands." At 3:00pm, Alan C. Walker, of Johns Hopkins University, will speak on "Extinction in Human Evolution." At 3:45 pm, Steven M. Stanley will speak on "Extinction in the Marine Realm."

Information on registering for the symposium may be obtained by writing the chairman, Dr. Nitecki, Department of Geology, Field Museum.

The exhibit "Master Dyers to the World: Early Fabrics from India" will remain on view in Hall 27 through April 10. Featured are superb pattern-dyed clothes made in India between the 15th and 18th centuries. 83540

Ron Testa

Maritime Peoples Of the Arctic and Northwest Coast

FIRST ANNIVERSARY CELEBRATION

Sunday, April 24

Join us for a special day of tours, films, art activities, and games as we celebrate the first anniversary of the opening of "Maritime Peoples of the Arctic and Northwest Coast." In this exhibit, Field Museum takes its visitors to another world—a world that changes from lush forests and teeming rivers to coastal fjords and bleak frozen tundras. Examine and compare two distinct cultures, the theatrically ornate Northwest Coast Indians and the austere but individualistic Eskimo. We invite you and your family to take part in the festivities.

12:00noon to 3:30pm	Northwest Coast Indian Matching Game
12:00noon	"Eskimos: Hunters of the North," tour
12:00noon	Film Feature: "The Crooked Beak of Heaven," (55m)
12:30pm	"The Totem Pole People," tour
1:00pm	"Kwakiutl Winter Ceremonies," tour
1:00pm	Film Feature: "People of the Seal: Eskimo Summer," (52m)
1:30pm	"Art of the Northwest Coast," slide lecture
1:30pm to 2:30pm	"Totem Pole Design," Family Art Project
2:00pm	"Treasures of the Totem Forest," tour
2:00pm	Film Feature: "Salmon People," (25m)
2:30pm	Film Feature: "The Eskimo in Life and Legend: The Living Stone," (22m)
3:00pm	Film Premiere: "Joe David—Spirit of the Mask," (24m)
3:30pm	Film Feature: "From the First People," (50m)

OUR ENVIRONMENT

Boy Bites (and Kills) Snake

A 14-year-old goatherd in Natal, South Africa, chewed out the throat of a 15-foot python to kill it before it could crush him to death, according to *South Africa Digest*.

The story would have remained untold if the shaken young man had not decided he wanted his picture taken with the dead snake.

He and two adults walked 15 miles to the nearest police station carrying the giant reptile in a box. The nameless youth told police he had suddenly found himself in the constricting coils of the python, with only a small club to defend himself.

Fortunately the snake's teeth became embedded in the head of the club and the boy avoided the nasty bite that pythons are capable of inflicting.

Then, as the snake's grip tightened, the boy sank his teeth into its neck and chewed until the snake was dead.

Fish and Wildlife Service Identifies Vertebrates that May Be Listed as Threatened or Endangered

Three-hundred-sixty-three United States fish, amphibians, reptiles, birds, and mammals that are being considered for addition to the List of Endangered and Threatened Wildlife have been identified by the Interior Department's U.S. Fish and Wildlife Service.

The list of "candidate" species includes 62 animals for which the service already has substantial information to support the biological appropriateness of proposing to list the species as endangered or threatened, and for which the preparation and publication of such proposals are anticipated. Also identified are 301 species for which further information is needed to determine whether they qualify for listing.

The majority of candidate species are fish (136), followed by birds (71), mammals (64), reptiles (47), and amphibians (45).

Also identified are 38 species that are no longer being considered as endangered or threatened. Among these are 14 species that are presumed to be extinct; six that are not regarded as taxonomically valid species or subspecies; and 18 that are more widespread than formerly believed or that are not presently subject to any identifiable threat.

The list of species included in the notice of review may be obtained from the *Federal Register* document or by writing to the Director (OES), U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. 20240. Comments or information on the listed species may also be sent to the above address.

At the present time, 296 species that occur in the United States and 468 foreign species are included on the U.S. List of Endangered and Threatened Wildlife and Plants.

Iowa's Backward Deer

About 500 deer in Iowa have their antlers on backward and the state is blaming the federal government.

These deer appear on the yellow deer-crossing signs along highways, said Richard Thornton, a member of the Iowa Conservation Commission.

"I noticed the deer on the signs about a year ago and couldn't believe it," Mr. Thornton said.

Dwight Stevens, an engineer for the Iowa Department of Transportation, said the agency "just used the design that's in our manuals" when they made the 500 signs. The manuals are published by the Federal Highway Administration.

Lower Forty-Eight's Caribou Declared Endangered

The last herd of woodland caribou still occurring in the United States outside of Alaska, Idaho's southern Selkirk Mountain herd, will be added to the endangered species list under an emergency rule, Interior Secretary James Watt has announced.

"Listing the caribou as endangered has been under consideration for nearly 10 years," Watt said, "but no action to protect the species was taken by previous administrations."

Only 13 to 20 animals survive in the population in Washington, Idaho, and southern British Columbia, making the woodland caribou the most critically endangered mammal in the "Lower 48."

The caribou occur primarily on National Forest lands administered by the U.S. Forest Service, which has taken necessary steps to protect the caribou's habitat. The population is threatened by poaching, wildfire, and collisions with vehicles. Poachers killed at least one animal from the herd annually from 1980 through 1982. Calf survival is low, possibly due to inbreeding in the small herd, and the herd is not being replenished by the immigration of woodland caribou from other populations in Canada, which also have been declining.

Woodland caribou (a different subspecies from the caribou of northern Alaska) once occupied nearly the entire forested region from southeastern Alaska and British Columbia to Newfoundland and Nova Scotia. In the lower 48, they were found in Washington, Idaho, Montana, Minnesota, Wisconsin, Michigan, Vermont, New Hampshire, and Maine. Largely because of illegal hunting and massive habitat alteration, caribou disappeared from New England by about 1908 and from the Great Lakes states by 1940. Woodland caribou populations in Alaska and Canada are not now considered to be endangered or threatened.

The southern Selkirk Mountain herd is eligible for protection under a provision of the Endangered Species Act that provides for listing of a "distinct population" of a vertebrate species that is endangered or threatened in a particular area, even though the species may be more numerous elsewhere.

Listing of the woodland caribou as "endangered" should improve coordination and management of federal agency actions that could affect the herd, facilitate international cooperation on the caribou's behalf, and provide for development of a caribou recovery plan that spells out actions that need to be taken to conserve the caribou.

The listing will also provide additional federal law enforcement protection for the herd. Poachers will be

subject to penalties under the Endangered Species Act, which can range up to $20,000 in fines, one year in prison, and forfeiture of vehicles and equipment used in the violation.

The emergency rule protects the caribou as "endangered" for 240 days, during which time the Fish and Wildlife Service intends to propose permanent endangered status for this population. No critical habitat was designated for the caribou under the emergency rule.

National Bald Eagle Program Aided by Private Support

Many more bald eagle chicks will be finding homes in the wild soon as a result of a major grant to the government bald eagle breeding program by the DuPont Company. The financial commitment to the U.S. Fish and Wildlife Service will enable the Interior Department agency to more than double the number of eaglets produced in captivity at its Patuxent Wildlife Research Center in Laurel, Maryland. The eagles are released in states where bald eagle numbers are low.

Researchers at the Patuxent Wildlife Research Center began breeding eagles in the mid-1970s and now have eight pairs — the largest captive bald eagle breeding colony in the world. Since 1977, the center has supplied 44 healthy young eagles to replenish eagle populations in nine states—New York, Virginia, Delaware, New Jersey, Pennsylvania, Maine, Georgia, Tennessee, and Ohio.

The eagles are returned to the wild through one of two techniques. In the "fostering" method, three-week-old eaglets are placed in nests built by wild eagles that laid no eggs or whose eggs failed to hatch. The eaglets are quickly accepted and cared for by their unsuspecting foster parents. In "hacking," slightly older chicks are placed in lofty towers constructed in a wild area and are fed by attendants (who remain out of sight) until the birds learn to fly and hunt for themselves.

Although a record 13 eaglets were produced in 1982, the Patuxent program still could not provide as many eaglets for release as were requested by state wildlife agencies. The DuPont grant will be used to restore a number of large eagle enclosures and to add personnel to care for eagles. As a result, the captive breeding colony will be enlarged to include 12 pairs of breeding birds. Through husbandry techniques developed by Patuxent researchers to increase the rate of reproduction, such a breeding colony could potentially supply as many as 36 eaglets to the wild each year.

Patuxent is the largest wildlife research center in the world and is well known for pioneering research on the effects of contaminants on wildlife, studies of bird populations and habitat, and field research on endangered species such as the California condor, as well as for captive breeding of whooping cranes, Andean condors, bald eagles, and other endangered species.

Fieldiana: 1982 Titles

Fieldiana is a continuing series of scientific papers and monographs in the disciplines of anthropology, botany, zoology, and geology; the series is intended primarily for exchange-distribution to museums, libraries, and universities, but all titles are also available for public purchase.

The following titles, published in 1982, may be ordered from the Division of Publications. Members are entitled to a 10 percent discount. Publication number should accompany order. A catalog of all available *Fieldiana* titles is available on request. (Please specify discipline: anthropology, botany, geology, or zoology.)

Fieldiana: Anthropology

1337. "The Speck Collection of Montagnais Material Culture from the Lower St. Lawrence Drainage, Quebec," by James W. VanStone. New Series Number 5. $7.00.

Fieldiana: Botany

1333. "Flora of Peru — Family Compositae: Part III—Genus *Mikania*—Tribe Eupatorieae," by J. Francis Macbride and collaborators, Walter C. Holmes and Sidney McDonald. New Series Number 9. $7.00.

1335. "Flora of Peru — Family Compositae: Part IV--Tribe Cardueae," by J. Francis Macbride and collaborators. Michael O. Dillon. New Series Number 10. $2.00.

1336. "Flora of Peru — Additions to Tribe Vernonieae (Compositae): I," by J. Francis Macbride and collaborators. Michael O. Dillon. New Series Number 11. $2.25.

Fieldiana: Geology

1331. "Systematics of the South American Marsupial Family Microbiotheriidae," by Larry G. Marshall. New Series Number 10. $10.50.

1332. "The Mammalian Fauna of Madura Cave, Western Australia. Part V: Diprotodonta (Part)," by Ernest L. Lundelius, Jr. and William D. Turnbull. New Series Number 11. $4.50.

1339. "Systematics of the Extinct South American Marsupial Family Polydolopidae," by Larry G. Marshall. New Series Number 12. $12.25.

Fieldiana: Zoology

1329. "Taxonomy and Evolution of the *Sinica* Group of Macaques: 3. Species and Subspecies Accounts of *Macaca assamensis*," by Jack Fooden. New Series Number 10. $5.25.

1330. "Neotropical Deer (Cervidae). Part I. Pudus, Genus *Pudu* Gray," by Philip Hershkovitz. New Series Number 11. $11.25.

1334. "Fishes of the Families Evermannellidae and Scopelarchidae: Systematics, Morphology, Interrelationships, and Zoogeography," by Robert Karl Johnson. New Series Number 12. $26.50.

1338. "Notes on Tyrant Flycatchers (Aves: Tyrannidae)," by Melvin A. Traylor, Jr. New Series Number 13. $3.00.

Plants of the World Photography Competition 1983

The splendid exhibit "Plants of the World" will open at Field Museum on September 24. Over 400 plant models, constructed of glass, paraffin, and natural materials, ranging in size from a few millimeters to eight feet tall form the finest and most complete collection of such models in the world. The models are surrounded by five magnificent dioramas and thirteen large murals. Within this impressive setting the museum visitor will have a unique opportunity to learn about and experience the mysteries of plant life.

In celebration of flowers and the exhibit's opening, the Museum announces the Plants of the World Photography Competition. For this event, all members who are photographers (regardless of residence) as well as nonmember photographers in the Chicago metropolitan area are encouraged to submit slides of flowers and plants without any further restrictions on subject matter—any subject in the realm of the plant kingdom is acceptable. The competition is divided into two age groups: Group I entrants must be under 17 years old as of August 1, 1983; Group II entrants must be 17 years or older as of August 1, 1983.

To enter, follow instructions and complete the form below. Slides must not be mounted in glass. Only original slides taken by the entrant that have not previously been published are acceptable. Indicate the proper slide orientation for projection with a dot in the upper right corner of the mounting on the non-emulsion side, together with your name and slide title.

Please make your check payable to Field Museum.

Delivery

Entries will be accepted between August 1 and August 15, 1983. Mail to:

Field Museum Photography Competition
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605

Please pack entries *with care*. Field Museum assumes no responsibility for damage or loss in shipment, delivery, and/or return.

Returns

Enclose a suitable self-addressed, stamped envelope for return of the entries. Entries that are not so accompanied will be discarded. Field Museum assumes no responsibility for damage or loss in return mail.

Awards

- Grand Prize: Reproduction of the winning entry as the front cover illustration of the October 1983 Field Museum *Bulletin*.
- First, Second, and Third Awards of Merit Group I and II: to be reproduced in the October Museum *Bulletin*.
- Six Honorable Mentions.
- Certificates of Selection.
- The prizes that will be offered will be announced in the May Bulletin.

Award-winning photographs will be on exhibition in Gallery Nine for the opening days of the Plants of the World exhibit, September 24 to October 9, 1983. The Museum reserves the right to publish, exhibit, and use for promotion the winning photographs. The decision of the judges is final.

Eligibility

Competition is open to photographers in the Chicago metropolitan area (Cook, Lake, McHenry, Kane, DuPage, and Will counties) and *all* museum members. Employees of Field Museum and the cosponsor and their immediate families are not eligible.

Entries

A completed entry form and entry fee of $5.00 must accompany each entry of one to three 35mm color slides. Entrants may submit three entries of 1 to 3 slides each (a maximum of 9 slides for the contest).

Entry forms are also available at Field Museum's Information Desk. The form may be photocopied for additional entries.

Join us in this celebration of flowers and photography.

Entry Form: Plants of the World Photography Competition

This form must accompany all entries. Use the guidelines above as a checklist.

Name_____ Daytime phone_____

Address_____
street

_____
City State Zip Code

Group I_____ Group II_____

Enclose $5.00 check or money order payable to Field Museum of Natural History.

I understand and agree to the conditions of the contest as stated in the above guidelines.

Signature: _____ Date: _____

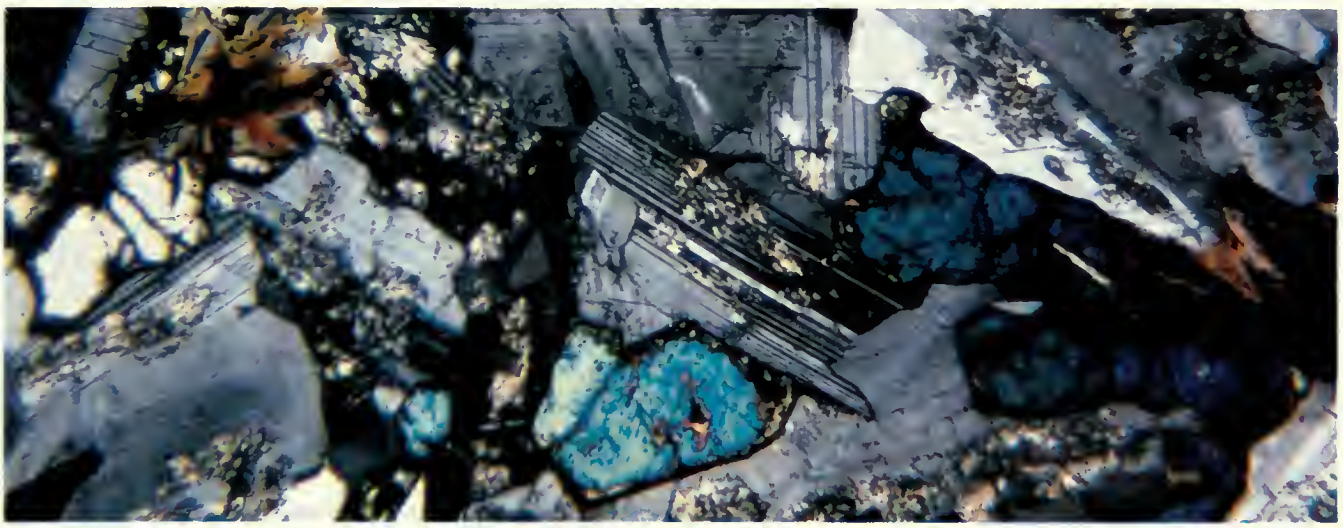
Thinsections: A Natural Art Form

text and photos
by Edward Olsen,
Curator of Mineralogy

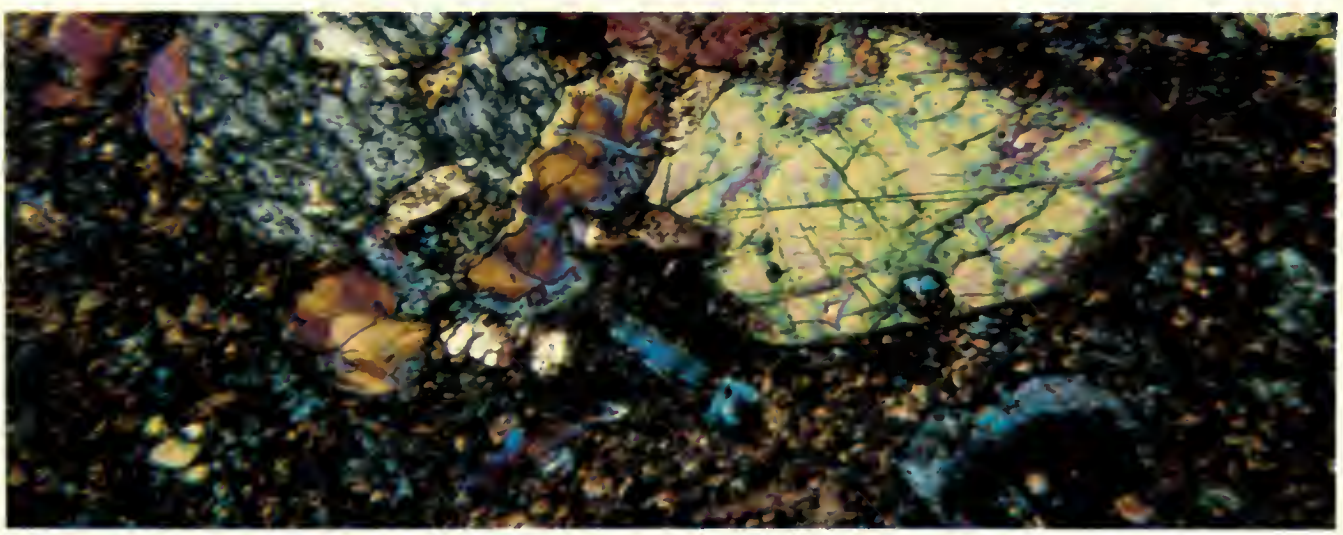
There is beauty in the natural world that surrounds us. Flowers, mountains, butterflies, brightly colored birds, leaves, branches, the many moods of sky, water, snow, and cloud, all please our eye as we pass through places and seasons.

Western European artists of the 18th and early 19th centuries attempted to depict the beauties and moods of Nature in an almost precise photographic way. With consummate skill they stopped time, capturing a fleeting mood or event, holding it in place to share with any who paused to view their work. The camera has, in part, taken over some of their art. These artists were followed by the great impressionists, many of whom painted Nature's moods in ways no camera could capture. These were followed by abstract impressionists, who use color and form in an attempt to extract the essence of beauty in the world around us.

What we traditionally think of as natural beauty is the surface of our planet, its creatures and its atmosphere, although our ventures into the space around Earth, and to some of the planets has broadened our perspective. The planet Saturn, viewed from a space probe, is breathtaking in its pattern of subtle colors, shadows, and spinning rings. Earth itself, seen from near space, is like abstract art — frosty swirls of white on a sapphire-blue sphere. There is abstract beauty beneath our feet. Within the pebbles



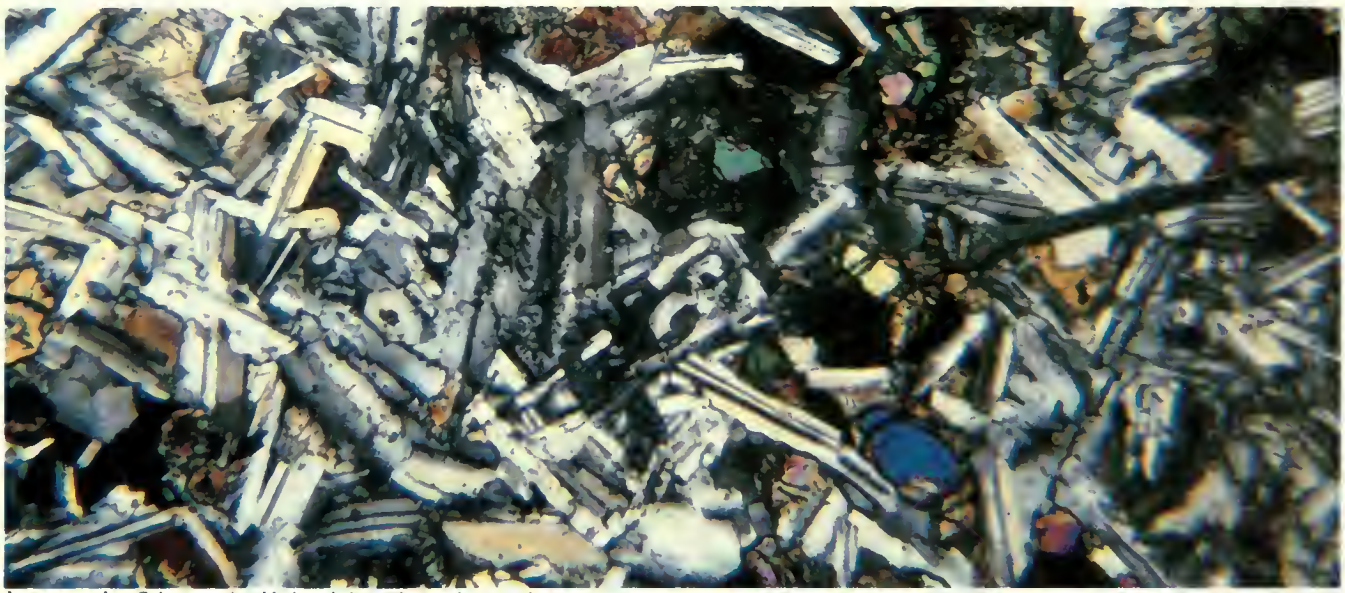
Igneous rock, consisting of olivine (blue and violet), pyroxene (white), and Plagioclase-feldspar (shades of gray). 100X



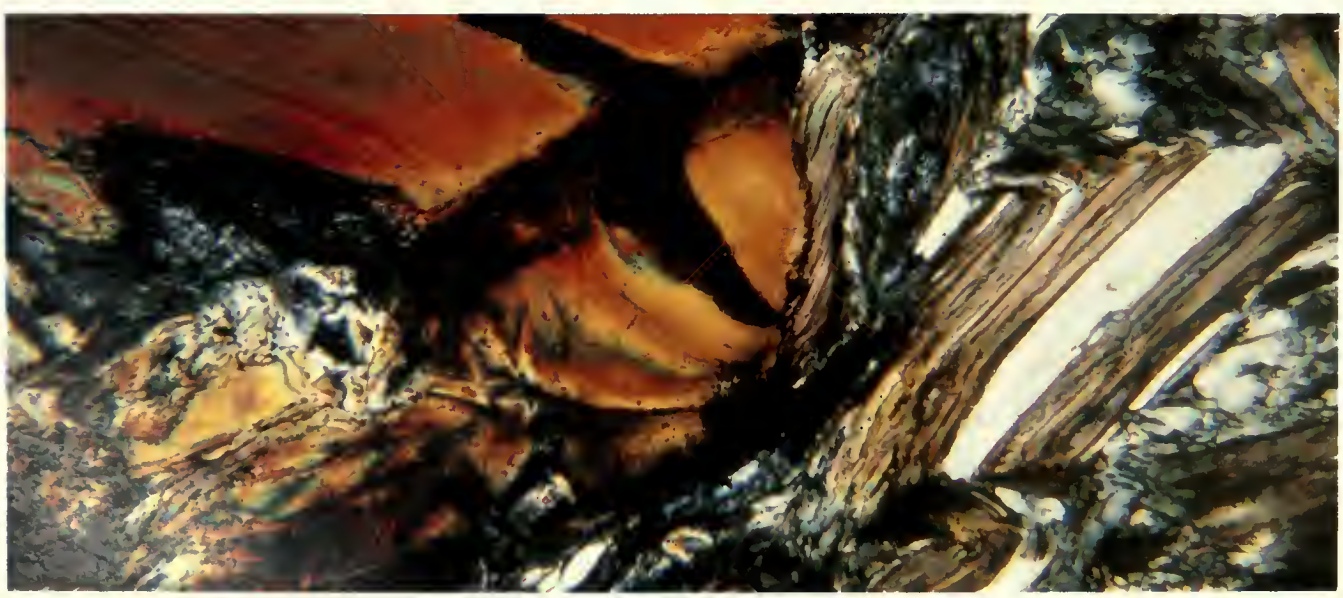
Volcanic rock—large crystals of pyroxene (bright colors and gray) in fine-grained matrix. 100X

of the beach, the gravels of the roads, the rocks of the mountains and deep beneath the surface are locked strikingly beautiful abstract patterns few realize are there.

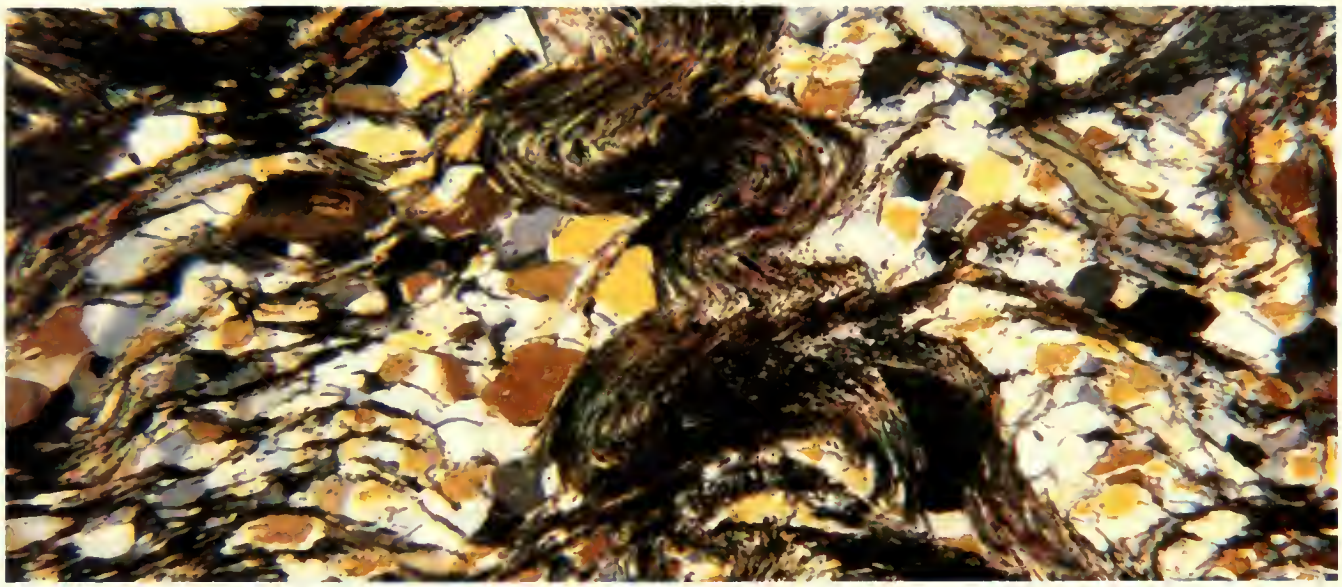
It was in the 19th century these patterns were first seen. The methods by which men had studied rocks and the minerals that comprise them were, until then, relatively simple. Shape, color, the overt patterns visible to the unaided eye or through a simple magnifier, were the only methods available. Then it was discovered that if a rock were cut flat and ground down to hair-thickness, light would pass through it. Viewed through a microscope the pattern of mineral grains could be seen and something could be learned of how the rock came to be formed as it was. Although some minerals of deep color still showed those colors when viewed this way, other minerals of weak to colorless hues all looked about alike. Then it was discovered that viewing these thin slices—called thinsections—in light that was polarized, different minerals took on different ranges of colors and this could be used to tell them apart. Polarized light uses the principle common today in the design of some sunglasses. How this operates physically is well understood but beyond the scope of this article. We need only appreciate that combinations of polarizers and other simple optical accessories create a rich display of colors —colors that depend on the physi-



Igneous rock—Criss-crossing blades of plagioclase (white) with blue, red, brown, and green crystals of pyroxene. 100X



 Metamorphic rock: biotite-mica (brown and tan) and quartz (white). 100X



Metamorphic rock: Biotite-mica (brown and tan) with quartz (white and yellow). 100X

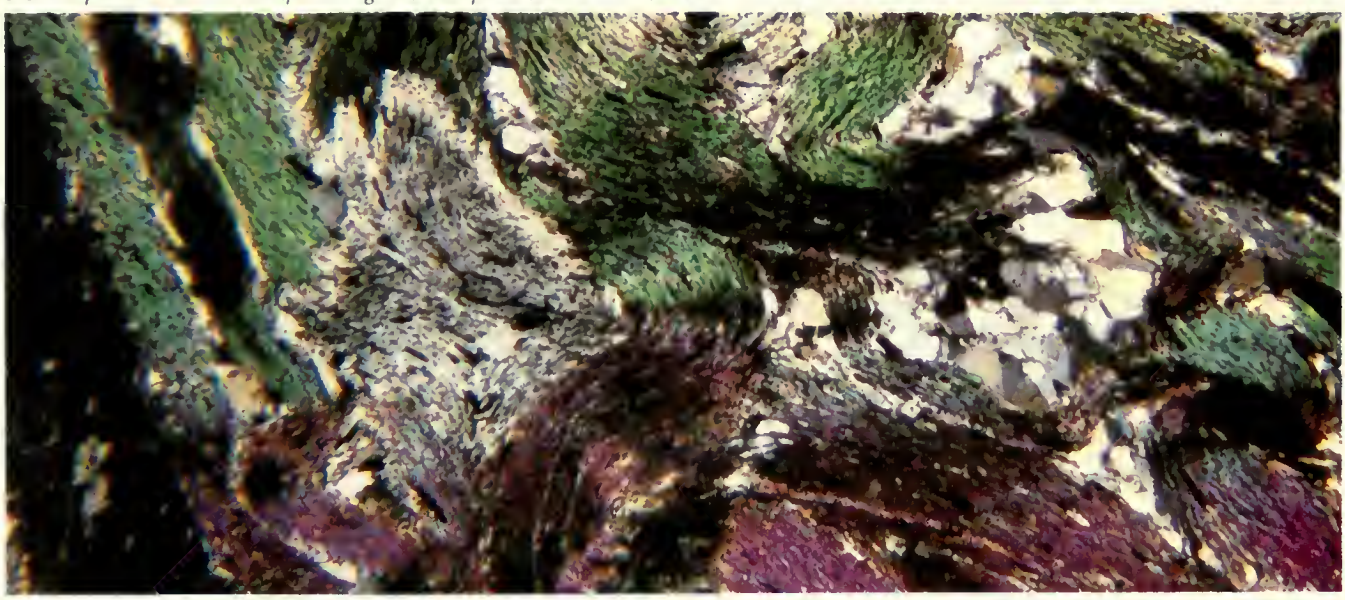
cal and chemical structure of the minerals to be found in any rock.

Reference books are available that permit the geologist to determine, on the basis of optical and color characteristics, which minerals are which. From this, much can be learned about the processes that have operated to form the rocks of the planet on which we live.

The photographs shown here were made of thinsections of a variety of rocks as seen through a polarizing microscope. To the professional eye of the geologist the patterns of shapes and colors tell stories of ancient upheavals in the crust of the Earth — tremendous pressures and heat that contorted, recrystallized, and reacted the minerals of these rocks; lavas that erupted onto the surface and flowed down the slopes of volcanos.

To the untrained eye the scenes are riots of color and form that move the imagination. As with abstract impressionism, each viewer sees what his or her imagination provides, recalling past experiences and moods. Many abstract impressionists chose to allow the viewer complete freedom of interpretation by leaving their works untitled. In a sense the pictures shown here are untitled; the rock names will not mean much to most viewers. These pictures are designed to please the imagination and the mind's eye—and to extend your awareness of the beauties of Nature, to the Earth deep beneath your feet. □

Metamorphic rock: Biotite-mica (pink and green) with quartz (white and tan). 100X



Athapaskan Indian Clothing In the Collections of Field Museum

by James W. VanStone
Curator of North American Archaeology and Ethnology

The Athapaskan-speaking Indians of central, western, and southwestern Alaska were contacted by Russian explorers in the late 18th and early 19th centuries, relatively late when compared with the first European penetration of other areas of North America. Their traditional material culture was modified quickly, however, and there were few opportunities for interested observers to make collections for preservation in European and American museums.

Traditional clothing changed more rapidly than other items of material culture, primarily because ready-made European garments saved work and were, in most cases, more comfortable to wear. It is little wonder, perhaps, that the Indians appreciated the special qualities of wool, which is warm and light and can be washed, as opposed to tanned caribou or moose skin, both of which are heavy and highly absorbent.

Although a number of museums have some items of traditional or modified-traditional northern Athapaskan clothing, usually undocumented, few have collections of any size. Ethnographers working in the field attempted to reconstruct aboriginal clothing styles for the Ingalik, Tanaina, western Kutchin, Han, and Upper Tanana (fig. 3), but their efforts have been handicapped by limited information available from their informants.

Collections in Field Museum's Department of Anthropology contain 31 items of northern Athapaskan summer clothing and related objects collected in the Yukon Valley of Alaska near the end of the 19th century. A representative sample of six specimens are described here and related to historical accounts from that period; some comments on provenience are also included.

Figure 1 shows the front of a tunic of tanned caribou skin decorated with a broad beaded band worked on a separate piece of skin

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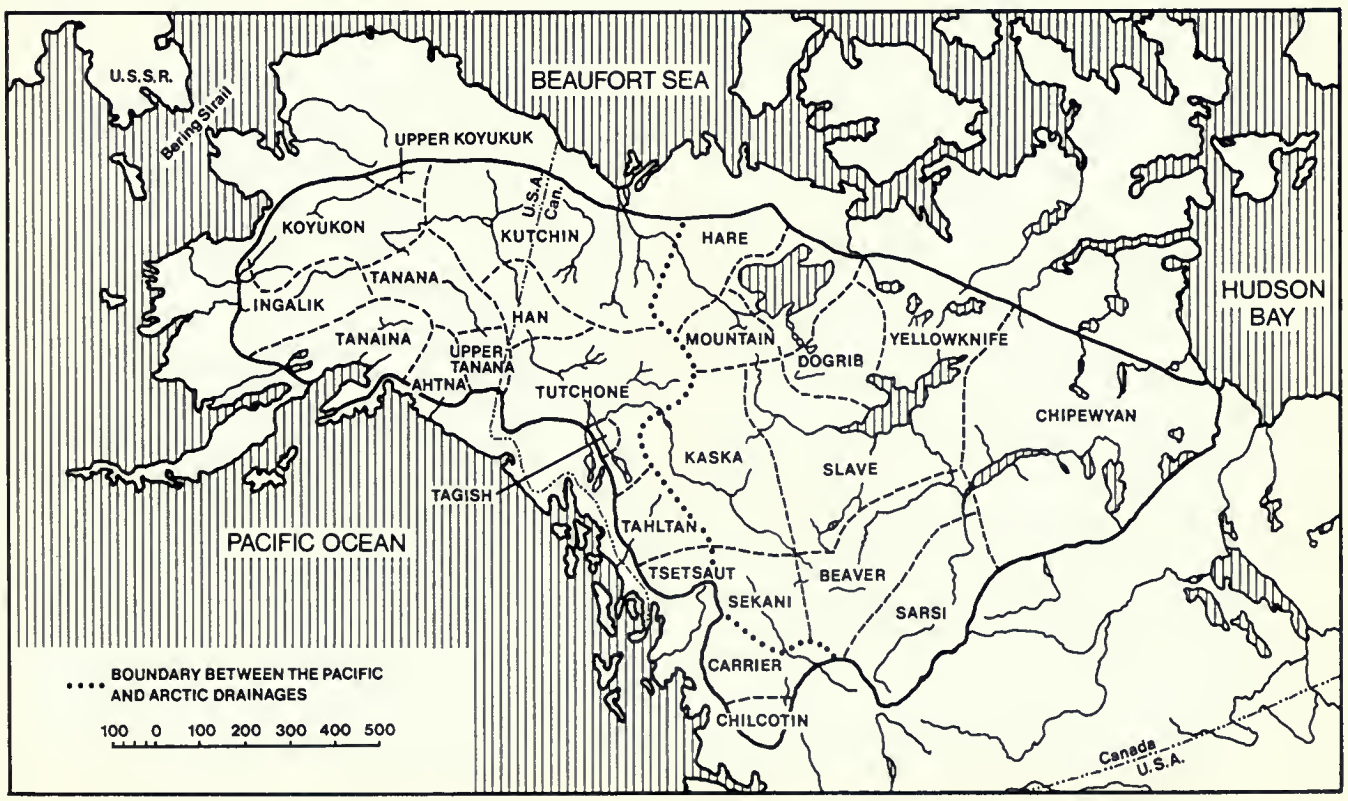
and attached, with a noticeable dip in the center, across the upper part to the backs of the shoulders. On the back of this garment, a similar beaded band extends across just below the armpits; radiating fringed rows ornament the pointed lower edges on both sides. This tunic has an extremely complicated pattern consisting of many separate pieces of skin. A single, large piece forms the back of the garment, folding over on the sides where it is joined to a flaring center section which extends down the front.

Another caribou skin tunic has an elaborate decorative band across the front (fig. 2), consisting of ten parallel rows of beads below which is an elaborate fringe. A simpler fringe in back extends along a line of red pigment. There are vertical lines of beadwork down the center points on both sides and a fringe along the lower edge. All the back and most of the front of this garment is made from a single piece of skin that extends over the shoulder.

These tunics adhere to the traditional Athapaskan form both in cut and decoration as it has been described among Alaskan and contiguous Canadian groups by early observers and ethnographers. A decorative band, quilled and/or beaded, extending across the chest and usually across the back as well and having a fringed lower edge is reported for the Ingalik, Koyukon, and various Kutchin groups. This decorative band is said to have been characteristic of both men's and women's garments.

The most frequently described characteristic of Athapaskan tunics is a bottom edge that is cut to a deep center point both in front and back. Among Yukon drainage and contiguous peoples, this is generally believed to have been a particular feature of men's garments, although among the Ingalik and Mackenzie drainage Kutchin it is mentioned as having been characteristic of the tunics of both sexes. In spite of the ethnohistorical and ethnographic evidence, it seems probable, on the basis of an examination of museum specimens, that the presence of pointed tunics is not necessarily or exclusively a male fashion. Drawings by Alexander H. Murray, a Hudson's Bay Company trader at Fort Yukon on the upper Yukon River in 1847-48, illustrate both the beaded bands and the pointed bottom edges previously mentioned (figs. 4 and 7).

Moccasin-trousers were the characteristic form of Athapaskan lower garment, worn by both men and women. Although few observers of contact-traditional Athapaskan life noted in detail their style of decoration, it is clear from the brief references which do occur that there was wide distribution of a design that included bands of beads or porcupine quills around the knee and down the front, with instep bifurcations joining an ankle band (fig. 8). The pattern of this typical specimen, one of six examples in Field Museum's collection, indicates that the legs and waist were cut from a single piece of skin,



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with separate pieces at the crotch and at the instep and soles of the moccasins. A drawing by Alexander Murray shows moccasin-trousers as well as tunics like those already described (fig. 9).

A Field Museum tunic that does not conform to the traditional pattern is a square-cut jacket that reaches to the waist and opens down the front. The most conspicuous feature of the decoration on this jacket is applied bands of woven, unsewn quillwork which extends down both sides of the front opening and around the garment's bottom edge. Similar bands occur around the sleeve ends and across each shoulder. The bands are worked on sinew and rectangular strips of skin (fig. 10). With the exception of the sleeves, this jacket is constructed of a single piece of skin folded, cut, and sewn in such a

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manner as to compensate for overlaps at the shoulders. A narrow piece is sewn around the neck opening.

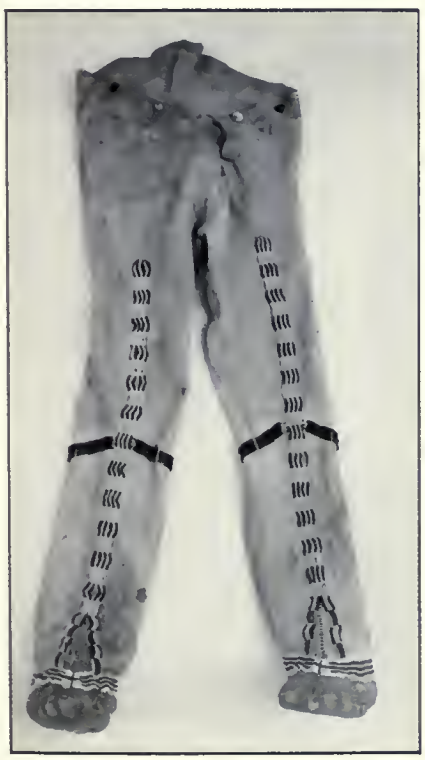
Jackets like this, combining native and European design, may be related to the chief's coat first mentioned by Murray as having been awarded in 1848 to a Kutchin at Fort Yukon for service to the Hudson's Bay Company. It is a style of coat which, utilizing different materials and new decorative motifs, has persisted until today among Alaskan Athapaskans.

The collection contains a complete child's costume of tanned caribou skin consisting of a tunic and a pair of moccasin-trousers. The tunic (figs. 5 and 6) has an attached hood and sleeves that are closed at the ends in the form of mittens; these have a slit in each cuff through which the hand could be extended. An important feature of the decoration on this tunic is a quill-wrapped fringe sewn to the garment. Just above the fringe is a band of plaited quills. The lower edge of the tunic is also ornamented with a quill-wrapped fringe.

Accession information accompanying this specimen suggests that it may have been originally collected at Fort Yukon in 1860-61. If this is accurate, the costume can, with some certainty, be attributed to the Kutchin. It would also be considerably older than most specimens of Athapaskan clothing in American museum collections.

Whether or not this attribution is correct, it is clear that the use of a hooded shirt with mittens sewn to the sleeves had a wide distribution among northern Athapaskans. The most distinctive feature of the garment is the attached hood; this feature is not characteristic of any other type of traditional Athapaskan tunic. The earliest sources make no mention of an attached hood, although Alexander Murray illustrates a child wearing what is apparently a parka in one of his sketches (fig. 12). Because of the widespread distribution of such a child's garment, the form was almost certainly known to Athapaskans in aboriginal times.

A hood, typical of four in the Field Museum collection, consists of a single V-shaped piece of tanned caribou skin notched and sewn at the upper end. The long and heavily beaded fringe on this specimen is, however, unusual (fig. 11). Virtually all illustrated hoods in various museum collections are more helmet-like than this and all are attributed either to the Kutchin or the Tanaina. Among most, if not all, Athapaskan groups, both men



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and women wore some kind of headgear and various types of "caps" are described in the literature. The detached hood, worn as an integral part of the summer costume, is believed to have been characteristic of female rather than male dress.

The decoration of clothing was the major artistic expression of northern Athapaskans and the most important traditional decorative elements were elaborate geometric designs in porcupine quills. Glass beads began to replace quills early in the 19th century, having been traded into the interior of Alaska from Hudson's Bay Company posts on the Mackenzie River and its tributaries and from Russian trading posts on Cook Inlet and at the mouth of the Yukon River. By 1885 some Indians used beads almost exclusively for decorating their garments; as late as 1865 Indians on the Tanana River, a Yukon tributary, were still skilled at quillwork decoration.

The introduction of beads eventually resulted in a shift from traditional geometric motifs to predominantly floral patterns. Beads permitted greater flexibility of design and were much easier to use than porcupine quills. Geometric patterns did not disappear quickly. Such designs are characteristic of the ornamentation on the specimens described here, but these designs are larger and less complex than the extremely fine work that was possible with the narrow, flattened quills. It is apparent that floral designs did not become truly popular until after the introduction of tiny seed beads and silk thread some time after 1900.

More significant than their decorative value, perhaps, is the fact that beads quickly became an important symbol of wealth among the various Athapaskan groups. Beads fitted easily into the native conception of values because of the precontact trade in dentalium shells. As the impact of the new economy increased toward the end of the 19th century, however, beads inevitably lost much of their value in the monetary sense. Nevertheless, as decoration they denoted wealth and influence. This certainly explains the amount of beaded decoration on some Field Museum specimens, an amount that adds considerably to the weight of the garments and undoubtedly made them awkward and somewhat uncomfortable to wear.

Given the absence of precise documentation, it is difficult if not impossible to assign provenience to the garments described and illustrated here on the basis of typological features alone. An examination of the literature and a comparison of Field Museum's specimens with published examples from other museum collections reveals that the clothing styles and decoration of western Athapaskan groups were very similar.

The documentation accompanying Field Museum's specimens may be inconclusive, but at least it provides an approximate

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date of collection and indicates that the specimens were collected, or at least originated, in that part of the Yukon valley within Alaska. This is hardly a precise provenience, but the fact remains that much of the area is within the territory occupied traditionally by only two groups, the Kutchin and Koyukon. Comparison of Field Museum garments with those described by early observers and with examples currently in museum collections indicates that however similar the style and decoration of all western Athapaskan clothing may have been, the tunics, moccasin-trousers, and hood described here bear an exceptionally close resemblance to descriptions of Kutchin clothing as well as to actual specimens with either tentative or positive Kutchin and Koyukon attributions. If the case for the former is stronger, it may only be because much more information is available both in the literature and through museum collections relevant to Kutchin clothing; thus, comparisons are easier. □

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COVER

Tsuzure Nishiki silk tapestry (detail). This extraordinary 22-by-13-foot work of art, on view in Hall 3, was first exhibited at the World's Columbian Exposition in Chicago in 1893. It was completed in that year by the firm of Jimbei Kawashima, Kyoto, Japan, and represents a religious celebration at the Temple of Nikko. Depicted in the procession are 586 men, wearing a variety of costumes. According to a newspaper account at the time of its initial exhibition, the quality of the piece exceeds even that of France's famed Gobelin tapestries, with about 33 warps to the inch. Photo by Ron Testa.

AN INVITATION TO:

Members' Nights

May 19 and 20
6:30–9:30 pm

Discover a whole new world at the Field Museum! Come to Members' Nights and learn about recently discovered plants from the tropics or the rediscovery of rare plants in our own area. View original bronze sculptures by Malvina Hoffman, learn about their historical background and how such works are restored. Discover meteorites in Antarctica, evolving monkeys in the New World, snakes in India, or sea serpents! No matter what your interest or age, you will be sure to enjoy our 32nd Annual members' Nights, on Thursday, May 19, and Friday, May 20, from 6:30 to 9:30 p.m. Entertainment this year will be provided by the Balkanske Igré Folk Orchestra, a group of six musicians who will perform folk music from the Balkan countries, eastern and central Europe.

Other evening highlights will include:

☞**Ground Floor**: Caribbean Reef Fishes: Systematics and Ecology; Amazonian Forest Fishes: Systematics and Ecology; Fish Skeletons: Preparation and Study; and Sea Serpents: Diversity and Research.

☞**First Floor**: Spotlighting Volunteers; Weave Awhile; Totem Poles, Masks and Shamans; Odd Man Out: The Botany Guessing Game; Living Jewels; and the Pawnee Earth Lodge.

☞**Second Floor**: The Vanishing Race and Other Illusions: A New Look at the Work of Edward Curtis; Of Catalogues, Calculators and Computers: The Scientific Computer at Field Museum; Walk through Time: A Guided Tour through the Collections of Fossils and Invertebrates.

☞**Third Floor**: Human Bones and Bronze Heads; Discover Anthropology on Postage Stamps; Women in the Field: Archaeologists and Ethnographers, Past and Present; Botanical Discoveries, Near and Far; Our Daily Bread; New Teeth for Fossil Reptiles and Amphibians; The Inside Story on Fossil Plants; How the Library Cares for Books (and How You Can for Yours); Homebodies; Aquatic Insects; Mammalian Montage; and Mountain of Birds.

☞**Fourth Floor**: Exhibitionists' Expo; and Design and Development.

Free parking will be available in the north Museum lot and the Soldier Field lot. Or use the free round-trip charter bus service between the Loop and the Museum's south entrance. These CTA buses marked "Field Museum" will originate at the Canal Street entrance of Union Station and stop at the Canal Street entrance of Northwestern Station, Washington and State, Washington and Michigan, Adams and Michigan, and Balbo and Michigan. Buses will run circuits beginning at 6:15 p.m. and continue at 15-minute intervals until approximately 9:45 p.m.

Reasonably priced dinners and snacks will be available in the Museum food service areas until 8:00 p.m.

To achieve a more even distribution of visitors, we suggest you follow this alphabetical schedule:

A through L	Thursday, May 19
M through Z	Friday, May 20

Admittance will be by invitation, so please retain your Members' Night invitation and present it at the door for admittance for you and your family.

Don't forget! Come to Members' Nights and discover a whole new world at the Field!

FIELD BRIEFS

Gift of Royal Azel

C.D. Peacock, Chicago jewelers, have given Field Museum an exceedingly rare royal azel gemstone, which occurs only in the Kalahari Desert of southern Africa, where it was found in 1975. Magenta with bluish overtones, it is the first new stone to be entered into the exclusive list of gems in decades. The Peacock gift includes both a faceted stone of 17.64 carats and a rough piece. They will be placed on exhibit in the Hall of Gems.

Eugene S. Richardson, Jr. 1916-1983

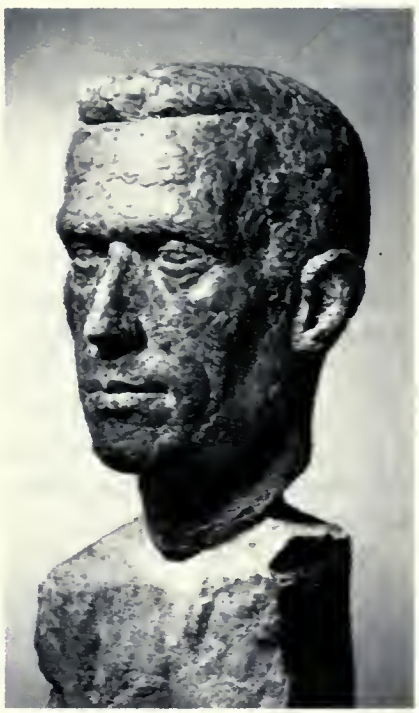
Eugene S. Richardson, Jr., who joined the Department of Geology in 1946 as curator of fossil invertebrates, died on January 21. Sixty-six years of age, he had been retired from his curatorial post only since the previous November.

A native of Philadelphia, Richardson held degrees from Williams College, Pennsylvania State University, and Princeton University. His primary area of interest as a paleontologist was the Upper Carboniferous, or Pennsylvanian Period, and he was noted as the primary investigator of the Carboniferous fauna of Mazon Creek, Illinois, one of the world's richest fossil sites of that geologic age. Visitors to Field Museum are familiar with his work first hand in Hall 37, the Hall of Invertebrate Paleontology, of which Richardson was the prime mover and planner.

He produced a large body of technical papers and articles; among his most widely acclaimed and cited works was *The Paleoecological History of Two Pennsylvanian Black Shales* (1963), coauthored with Rainer Zangerl. It was in the belles lettres essay, however, that Richardson's unusual literary skills were particularly manifest. Here his special gift for irony and mordant wit had free rein.

In addition to his professional activities, Richardson had wide-ranging intellectual, cultural, and aesthetic interests—a renaissance man in the truest sense. Richardson was competent in a number of foreign languages as well as the classics; among his scholarly activities was research in the Dutch Colonial history of the West Indies. At his country home, near Gurnee, Illinois, he operated a small letterpress, setting all type himself and producing from time to time artfully wrought publications of various small format under the imprint The Vanishing Press, which he distributed among his friends and acquaintances.

A man of uncommon personal integrity, intellectual élan, and generosity of spirit, he was also blessed with that capacity to regard the experience of life as the supreme adventure; Gene Richardson belonged to a most exclusive company. His friends, Field Museum, and the world that felt his presence are much the better for the time he shared with us.—*D.M.W.*



Bust of Eugene S. Richardson, Jr. by Tibor Perenyi, former Field Museum scientific illustrator who retired in 1978 and now resides in Vienna, Austria. The bust was recently on view in Budapest in an exhibition of works by artists of Hungarian birth who now live in another country.

"Science in Action": Free Summer Courses in Anthropology and Biology for High School Students

The Department of Education's new three-week course in biology starts June 20 and ends Monday, July 11. The Summer Anthropology Course, now in its eighteenth year, meets for the usual six weeks, from June 27 through August 5. Any able, highly motivated high school student may apply for either (but not both) of these courses.

Both programs make fullest use of their Museum setting and are taught at college level by Museum staff and university professors who embody their own field of specialization in each science. Participants will engage in workshops, individual projects, and field studies, and will visit laboratories and collections behind the scenes.

The biology course includes two days of collecting in the field; the anthropology course has scheduled field trips to examine ethnohistoric documents in Chicago's Newberry Library and to tour Chicago's ethnic neighborhoods. In addition, the fifth week of the anthropology program will again be devoted to the archaeological excavation of a local prehistoric site.

Hours of both courses are weekdays 9:15 a.m. to 3:00 or 3:30 p.m., except during the week of the dig, when the charter bus leaves Field Museum at 9:00 a.m. and returns by 5:00 p.m.

Field Museum's Spensley Fund supports half of each of these high school programs, with the other half of anthropology again funded by the University of Illinois at Chicago and of biology by the Ray A. Kroc Environmental Education Fund. Program directors and coordinating instructors are Elizabeth Deis, biology instructor, Department of Education; and Harriet Smith, anthropology instructor emeritus, Field Museum.

A brochure and application form are available by calling (312) 922-9410, ext. 246. Completed applications will be due at the Museum by May 13. Interviews with the highest-rated applicants will take place May 14 through 28. Notification of final selection will be made on June 2.

TOURS FOR MEMBERS

Need A Getaway Weekend?

Take one with a purpose this spring and enjoy the rewards for many weeks to come. Join our group, under the expert leadership of Dr. Edward Olsen, curator of mineralogy, as we explore Wisconsin's Baraboo Range. Departure Saturday May 14; return Sunday, May 15. Price $125.00 (includes meals, and transportation from Field Museum and return). This is one of our most popular trips. Space is limited

William Burger

Costa Rica Tour

January 14-27, 1984
Leader: Dr. William Burger,
Chairman of Field Museum's
Department of Botany

Kenya

With Optional Extension
To the Seychelles
$3,395
Seychelles Extension $1,350

A really exciting adventurous and in-depth safari carefully planned under the expert guidance of our leader, Audrey Faden. This is the third consecutive year Audrey has led this tour for Field Museum. She is a former staffer of the National Museum of Kenya and her keen interest in wildlife, conservation, and plant life make her a natural to lead our tour. If you have an inquisitive mind and would like to learn about the wildlife, ecology, and plant life, this safari should be your choice. Photography will be a major objective on this tour and our specially equipped safari vehicles will provide clear visibility for all participants.

For further information on any tour, please call Dorothy Roder at 322-8862 or write Field Museum Tours.

Tradition of Chado—The Way of Tea

with The Urasenke Tea Ceremony Society

Sunday, May 1, 2:00 pm
Stanley Field Hall

The popularity of tea is worldwide, but nowhere does tea contribute as much to the cultural milieu as in Japan. *Cha-no-yu*, which literally means "hot water for tea," is known in the Western world as the tea ceremony. In Japan the preparation and drinking of tea has acquired aesthetic and spiritual significance and has developed into a distinct artistic accomplishment. The ceremony is not only based in the etiquette of the service, but in the contemplation of landscaped gardens, tea utensils, paintings, flower arrangements, and all of the elements that coexist in a harmonious relationship with the ceremony. The philosophy of chado is based on four concepts: *Wa*—harmony, *Kei*—respect, *Sei*—purity, and *Jaku*—tranquility. The ultimate aim is deep spiritual satisfaction through the constant practice of these four principles.

On Sunday, May 1, at 2:00pm The Urasenke Tea Ceremony Society invites you to observe "the Way of Tea." It is the belief of the followers of the Urasenke tradition that the Way of Tea can be the foundation of a way of life; that peacefulness from a bowl of tea can be shared with anyone. Join us in Stanley Field Hall for this fascinating performance and demonstration of Chado—the Way of Tea. This performance is free with Museum admission and tickets are not required. All Arts of the Orient programs are partially funded by a grant from the Illinois Arts Council.

PHILOSOPHY OF CHADO

A Unique Synthesis of Traditions

The underlying philosophy of Chado evolved from Zen Buddhism. *Zen* is the Japanese counterpart of the Chinese word *ch'an*, which is a translation of the Sanskrit word *dhyana*, meaning the meditation that leads to deep spiritual insight. There is a saying that "To study the Way of Tea is to study Zen." This emphasizes that potentially it is a rigorous spiritual discipline, a way of training body and mind in awareness. Sen Rikyu summarized the principles of the discipline of chado in four concepts, *wa, kei, sei,* and *jaku*.

Wa, harmony. This is a feeling of oneness with nature and people. At a tea gathering, there should be harmony between host and guest, guest and guest, mood and season, the food served and the utensils used. Sensitivity to the changing rhythms of the seasons, and harmony with these changes pervades Chado. According to the season a host chooses utensils, flowers, and scroll, and uses either a portable brazier or a sunken hearth. The unpredictable nature of weather is an integral part of a tea gathering and is not to be shut out, ignored, or considered inconvenient. This harmony with nature quietly leads one to an understanding of the evanescence of all things and the unchanging in the changing.

Kei, respect. Respect, naturally resulting from a feeling of gratitude, is extended not only to people but also to the utensils used, and to our daily lifestyle. The etiquette of the tearoom helps one to learn to apply the principle of kei. To the uninitiated what may appear at first as an excessively strict and formal etiquette is in actuality a means of teaching kei. The hospitality of the host, the concern of the guests for each other and the host, and the careful handling of the utensils exemplify this respect.

Sei, purity. Cleanliness and orderliness, in both the physical and spiritual sense, is a very important part of the study of Tea, just as it is in Zen training. Rikyu must have learned the importance of simple cleaning in his study of Zen. In Zen, even the most mundane acts—washing dishes or cleaning floors—are the seeds of enlightenment. In the words of a man of eighth-century China, "How wondrous this, how mysterious! I carry fuel, I draw water." When the host cleans his utensils he is simultaneously purifying his heart and mind through his total concentration on his task. The guests, before entering the tea hut, pass along a garden path and rinse their hands and wash out their mouths at a low stone water basin, thereby symbolically purifying themselves of the "dust" of the everyday world outside the tearoom. Sei also implies simplification, the elimination of all unnecessary elements. The appearance of the garden path and tea hut are examples of this kind of simplicity. The path is only to lead the guest to the tea hut and is without expansive views or artful details. After a tea gathering, the host sits in solitude in the tea hut to reflect for a moment. He then cleans the hut and stores the utensils away. The room is again bare. If a room—like our lives—is cluttered it is difficult to keep clean and ordered.

Jaku, tranquility. Through the constant practice of wa, kei, and sei one is prepared to approach the utter stillness and silence of tranquility. But this tranquility is not the familiar psychological state but a spiritual state that transcends one's mind and body even as it emanates from it. It is the dynamic force of one's innermost being that infuses the practice of Tea. Without it a tea gathering loses all significance.

The philosophy of Chado has also been influenced by Shintoism. Acute sensitivity to nature is a striking characteristic of Japanese culture and far predates the introduction of Buddhism and Chinese influence. To the Shinto believer, nature is considered sacred and endowed with spirit. The emphasis on purity and cleanliness also probably derives from a Shinto belief that true and natural beauty is not revealed if covered with dirt. The practice of cleansing hands and mouth at the stone water-basin before entering the tea hut almost certainly is rooted in Shinto. Before entering a Shinto shrine, one goes through a similar ritual.

Through Zen, Chado is also linked with Chinese Taoism. Chado literally means the "Way of Tea," and the character for "do" (*tao* in Chinese) is translated as "way" or "path." Tao is often explained as being the Way of the Universe, or the Way of Ultimate Reality. Taoists believed that to know his true nature, man should order his life so as to be in harmony with this way. Sitting meditation and breath control were practiced, and cultivation of both spiritual and physical cleanliness, were important means of developing inward awareness. In other words, true reality can only be perceived in a life that is "garnished and swept," where all is clean.

Later, the term *tao* came to be used in Chinese and Japanese Buddhism to indicate the "Way of the Buddha." In Japan, it has also been used to denote various disciplines deriving from Zen: Chado or the Way of Tea; *Kendo* or the Way of the Sword; *Shodo* or the Way of the Brush (calligraphy).

The underlying philosophy of Chado is a rich and unique synthesis of oriental cultural and religious tradition. Summarized by Sen Rikyu, the four principles of Chado are harmony, respect, purity, and tranquility. Constantly practicing these four principles, whether in the tearoom or not, will increase one's spiritual awareness and help one to find inner peace. — *Urasenke Foundation*

Eastern and Western Traditions In Hand Papermaking

by Timothy Barrett

photos by the author

Every autumn in Japan, as the rice harvest ends and farming tools are put away,[1] the leaves begin to fall from the paper mulberry, or *kozo*, trees signifying their readiness for harvest. Farmers all over the country remove a different set of tools from storage and, as the weather grows colder, a cycle that has been repeated for centuries begins again.

Working as a group, the farmer-craftspeople of the community cut and bundle the trees, then steam the bundles for two hours to soften the bark. Sitting and chatting about all that has happened since last year's kozo harvest, they strip the valuable bark from the unwanted inner wood. The stripped bark is dried outdoors, then baled for storage. Later, when more time is available, the bark is first soaked in a clear stream, then carried to a workshop area. There a flaky layer of black outer bark is carefully scraped away with a knife. Thoroughly rinsed in clear water, the clean bark is then hung in the fresh air to dry.

In a dammed-off part of the stream, the cleaned bark is soaked yet again, sometimes for days, to lighten the color of the fiber. Following this natural bleaching step, it is cooked in a solution of lye made from wood ashes (gathered from cooking and bath water fires). The nonfibrous parts of the bark are thus softened and eventually liquified, leaving only the fiber requisite for making paper. Gentle rinsing of the cooked bark strands in clear cold water removes any remaining lye solution. To ensure that the final product will be defect-free, each strand of cooked bark is scrupulously inspected by hand in cold water and any specks or discolored matter are picked away. The evening before sheets are to be formed, or very early the next morning, the bark strands are hand-beaten to loosen all the individual fibers from one another.

A measured amount of fiber is than added to a vat of cold water and thoroughly mixed until all fibers are well separated. A stringy, viscous material rendered from *tororo-aoi* root[2] is added to the fiber-

1. Kozo (*Broussonetia Kazinoki* Sieb.) is but one of three species from which the white inner bark or *bast* fiber is harvested for Japanese hand papermaking. The other two trees are *mitsumata (Edgeworthia papyrifera* Sieb. et Zucc.) and *gampi (Diplomorpha sikokiana* Nakai). Both are processed in a manner similar to that outlined for kozo.

Leaves of the paper mulberry, or kozo

2. Tororo-aoi is a species of hibiscus raised every year especially for papermaking. Botanical names are *Hibiscus manihot* L. or *Abelmoschus manihot* Medikus, depending on the reference. The viscous product from tororo added to the vat is not a mucilage, glue, or size. The term used here is "formation aid," since its main function is to change the nature of the water and fiber mixture, dispersing the fibers and slowing the overall drainage rate. Any substance with an adhesive quality would interfere with parting of the sheets after pressing.

water mixture, initially to promote dispersion of the very long (1 centimeter average) kozo fibers.

After a second light mixing, the fibers are ready to be formed into sheets. The papermaker grasps his sheet mould—a type of flat sieve—and dips the near edge into the vat, flooding the mould surface with the viscous mixture. The solution is poured off the far side. More solution is gathered along the near edge of the mould; this time, however, the solution (contained by the "deckle"—a rectangular frame on top of the mould) is sloshed back and forth across the mould's porous surface. As the sloshing continues, the liquid portion of the mixture passes through the sievelike mould surface; the fiber is contained on top, gradually forming the first layers of a sheet.

At this point, the viscous tororo-aoi additive serves to retard the drainage rate. It is the combined effect of the tororo-aoi formation aid, the sloshing sheet-forming action, and the unusual fiber length that enable the Japanese to create such very thin, even, and delicate papers. In producing an exceptionally thin tissue paper, the vat mixing begins with a very small proportion of fiber to water, and formation aid is then added until the drainage rate is slowed enough for controlled sheet-forming.

When the desired sheet thickness is achieved, solution remaining in the mould is tossed off the far edge. The flexible bamboo splint and silk-thread surface, or *su*, of the mould is then removed and lowered (with the new sheet of paper adhering) down and across a pile of previously stacked damp sheets. The su is then drawn away, leaving the new sheet smooth and unwrinkled atop the others. The craftsman returns the su to the mould to form another sheet; by the end of the day 300 to 500 sheets will be accumulated.

Mr. Barrett will provide a lecture demonstration on "Japanese Tradition of Papermaking" on Saturday, May 14, 2:00pm in Stanley Field Hall.

Bundles of cut kozo *prior to steaming*

Stripping bark from inner wood

The next day the stack of paper is pressed to remove excess water and strengthen the paper. The sheets are then peeled, one by one, from the stack. The paper does not stick together mainly because the exceptionally long fibers have been laminated into the highly cohesive individual sheets during sheet-forming. Each damp sheet is then carefully brushed smooth onto wooden boards and taken outdoors on the boards to dry in the sun. After the dried paper is stripped from the boards, it is inspected, packaged, and the finished product is ready for the customer. Throughout the long winter months, the same routine is repeated again and again.

In the spring, new shoots arise from the stumps where last fall's trees were cut, the craftspeople put their papermaking tools away for

Timothy Barrett, who produces Japanese and Western handmade papers at his Kalamazoo, Michigan, workshop, has been involved in this rare craft for a decade. From 1975 to 1977, on a Fulbright Fellowship, Barrett studied traditional papermaking methods in Japan. He is currently completing his second book on the subject.

Bleaching in stream

Straining foreign matter from viscous tororo-aoi *formation aid*

another season and return to rice planting. The papermaking cycle works in direct harmony with the cycles dictated by nature. It is no wonder that the finished paper embodies so much character and life.

Traditionally made Japanese paper has a natural warm color, a lustrous sheen, and a curious, strong, crisp, yet soft feel; it has a suppleness reminiscent of deerskin, and a quality totally unlike that of machine-made paper. Unfortunately, and surprisingly, papers of this sort are rarely made in Japan today, even though at least 500 papermaking houses are still at work. As is the case with many other traditional hand crafts, the use of natural raw materials and the reliance on time-consuming, natural processes have gradually given way to modern scientific approaches and to demands for a cheaper product.

Today, although a few houses still use traditional methods, fiber is usually grown by non-papermaking farmers, soaked and washed only minimally, cooked (and sometimes bleached) with chemicals, and beaten with machinery. The traditional kozo fibers are often mixed with foreign bark fibers and wood pulp (commercially prepared from hardwood or softwood trees), and the sheets are made all year round, so that the materials are not always kept fresh by cold working conditions. The finished sheets are often dried on heated indoor sheetmetal surfaces. Although considerably cheaper and perhaps just as permanent as traditionally made paper, the sheet produced by means of these newer materials and methods often lacks the strength, the golden warm natural color, the strong soft-crispness, and the luster of papers made in the traditional way; all these qualities have been compromised or eliminated in the new paper. Fortunately, these traditional paper-

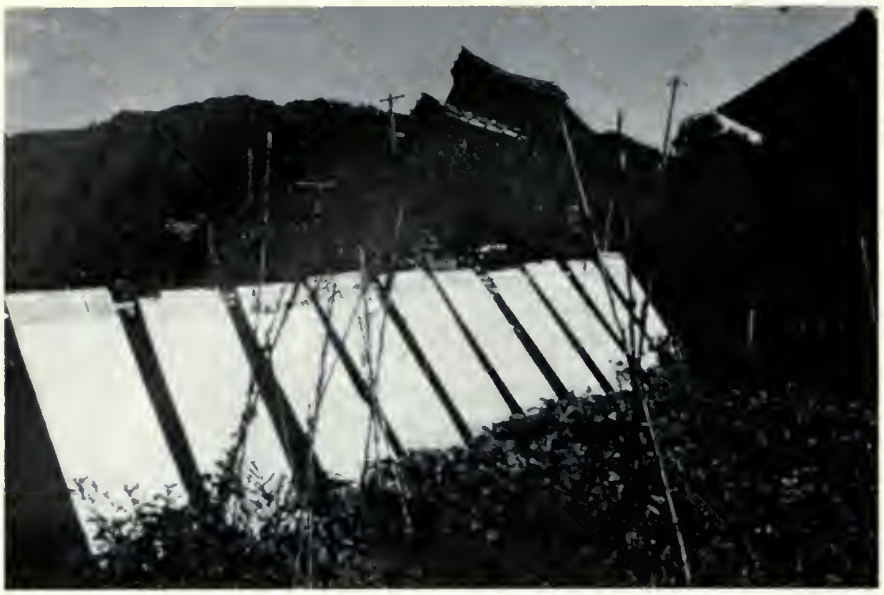
making methods — though still uncommon — are being perpetuated by a small, though dedicated group of young Japanese.

There are rich and important lessons to be learned by a Westerner living and studying in a culture where the traditions go back so far. But ironically, the most important lesson for such a visitor concerns not the culture and craft he went abroad to study, but his own. As the result of my two years' study in Japan, I have grown to respect the Western hand papermaking traditions as well. For me, these are no longer simply "old out-of-date methods," but the collective work of generations of unknown craftsmen —accumulated lessons that were passed on as a package from one generation of artisans to the next.

In Japan, by talking and working with craftspeople, it is possible to directly absorb many centuries-old traditions. Much of the early European papermaking process, however, died out centuries ago. Young contemporary craftspeople interested in the early European techniques have considerable research ahead of us if we are to fully understand and possibly apply the older methods in the contemporary craft.

Some papers used in books produced in Europe between 1450 and 1700 remain not only surprisingly strong, but have a warm white natural color, a creamy richness and pliancy uncommon in contemporary papers. In large part, this can be attributed to the linen and hempen rags used as raw materials, to the slow, careful fermentation of rags prior to beating, to the natural loft (air) drying of the finished sheets, and perhaps as well to the gelatin surface size that was used to finish the paper. Western hand papermaking retains few of these steps in its present form, and although the sheet (like contemporary Japanese paper) is

Top: *Forming sheets.* Middle: *Adding a newly formed sheet to stack of wet paper.* Bottom: *Peeling new damp sheet from stack after pressing.*



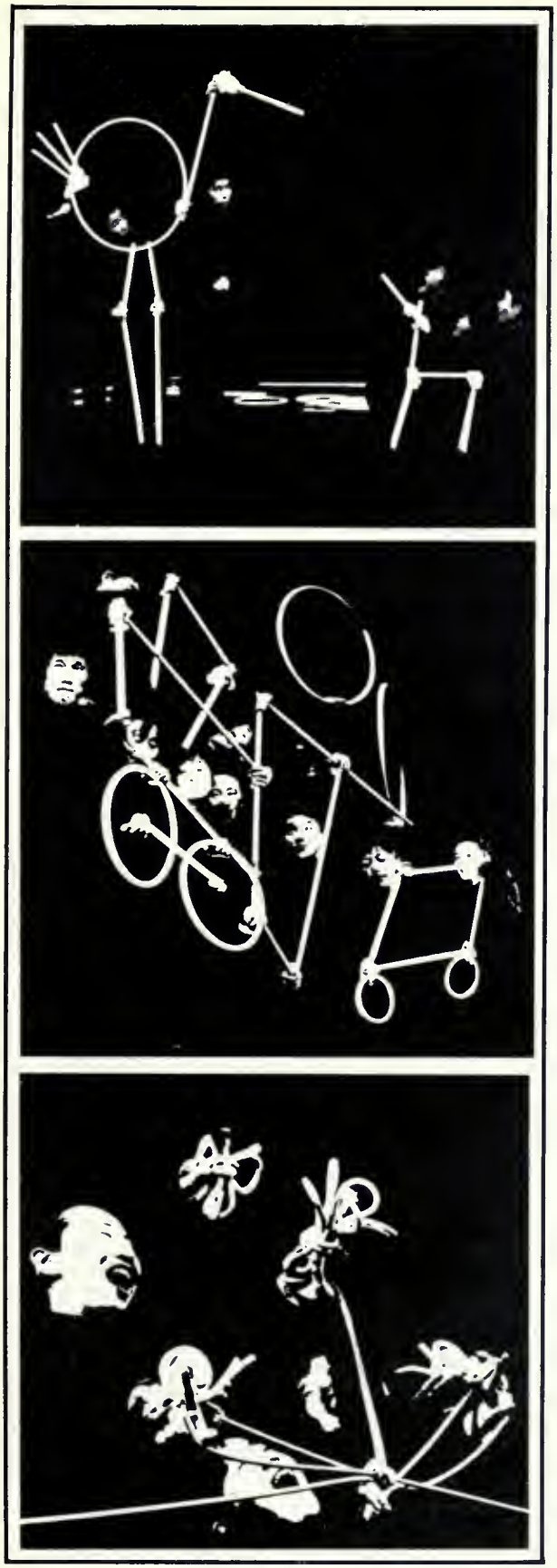
Fresh paper brushed onto boards, drying in sun

formed by hand, is reasonable in price, perhaps long-lasting and durable, *and* is receptive to the artist's brush or the printer's ink, we are not likely to see in it the warm natural color, or feel that rich, supple, creamy texture. The possibility of renewing certain old European traditions and applying them to the contemporary craft is one of the most exciting and potentially rewarding aspects of working in the hand papermaking field today.

Persons interested in further reading on Japanese and Western hand papermaking should consult Dard Hunter's *Papermaking—History and Technique of an Ancient Craft*, originally published by Knopf (1943) but now available as a Dover paperback. Sukey Hughes treats Japanese hand papermaking in *Washi—the World of Japanese Handmade Paper* (Kodansha, 1978). My own *Japanese Papermaking—Traditions, Tools and Techniques* is to be published this fall by John Weatherhill, Tokyo and New York. □

Forming western-style sheets.

Traditional packaging of finished paper



Kaze-no-ko

"Children of the Wind"

Sunday, May 8
2:00pm
James Simpson Theatre

Tickets: Members $6.00; nonmembers $8.00

Kaze-no-ko is Japan's leading children's theatre. With hoops, sticks, and balls magically transformed into horses, herons, caterpillars, and a whole assortment of marvelous creatures, the troupe rekindles the spark of creativity in each of us.

Under the guidance of artistic director Yukio Sekiya, the troupe is dedicated to arousing and developing creativity. Using a technique called animime, which involves basic props such as sticks, hoops, and ropes bent into imaginative shapes by nimble fingers, Kaze-no-ko tells the story of a colt seeing the world on its first day. The hands and arms of the troupe create the almost lifelike shapes of turtles, swans, and crabs, and the beautiful story of the Ugly Duckling is retold with paper ducks created through the Japanese art of paper folding—origami.

Kaze-no-ko is a joyous visual experience for the whole family. Don't miss the opportunity to share a creative experience with this troupe which has thrilled audiences the world over.

You are encouraged to order tickets in advance for this special event. Tickets are sold at the door on a space available basis only. for further information please call (312) 322-8854.

Patronage of Tz'u-Chou Type Wares

by Yutaka Mino

Tz'u-chou type wares have enjoyed one of the longest histories of any major group of Chinese ceramics, having been produced since the tenth century at numerous kilns in north China. Modern interest in these wares has been stimulated by excavations made at ancient kiln sites, and these recent discoveries, particularly those of the last 25 years, have resulted in an extensive body of new information.

Tz'u-chou ware is named for a major site of its production and the principal center of the ceramic industry in northern China, Tz'u-chou, known today as Tz'u-hsien, in southern Hopei province. The success and longevity of Tz'u-chou type wares is chiefly explained by the fact that they never benefited from official patronage or from export revenues, and that they were established on a popular and domestic economic base.

Unlike most other Chinese ceramic wares, the development of Tz'u-chou wares was not interrupted by the overthrow of dynasties. Their discovery, in rare cases, in Japan, eastern Java, Borneo, and the Celebes has led some to believe that they may have been an "export ware." But the numbers found abroad are so insignificant that it is unlikely that they were made, as were some other Chinese wares, just for a foreign market.

Yutaka Mino is curator, Oriental Art Department, Indianapolis Museum of Art.

Ancient Tz'u-chou kiln sites at P'eng-ch'eng-chen in Tz'u-hsien. Photo courtesy the Tz'u-hsien Cultural Bureau, Hopei province.

The Tz'u-chou kilns sprang up to supply a growing popular market in the early Sung period (960-1280) when prosperity and stability produced a rising standard of living for the common people. Judging from the large proportion of dishes, bowls, jars, and ceramic pillows found at kiln sites, a large part of the production of the Tz'u-chou wares consisted of household items.

Thousands of examples of such wares were found at the site of the Sung town of Chü-lu in Chü-lu-hsien, southern Hopei province, destroyed by floods in 1108. A stele in Chü-lu records that in the autumn of the second year of Ta-kuan (1108) the Chang River broke its banks and flooded the town, burying nearly everything in as much as twenty feet of mud. Discovered accidentally by local residents in 1918, much of the site was pillaged, and the best ceramic finds were sold to dealers and shipped out of China. By the time the Tientsin Museum sent a team to Chü-lu-hsien in 1920 to investigate, it was able to acquire a sampling of the wares only by paying rather inflated prices. A 1923 report published by the Tientsin Museum lists objects such as bowls, lobed jars, two-handle jars, pillows, basins, vases, and ewers of Tz'u-chou type ware. Many pieces have ink inscriptions on the base, recording their purchase, price, date, and the buyer's name. None of these pieces are dated later than A.D. 1108, the flood year. One pillow bears an inscription on the base that commemorates a wedding day in the second year of Ch'ung-ning, or 1103. A bowl-shaped lower portion of a covered box — presumably a container for herbal medicines — bears its purchase date: May 25 in the second year of Ta-kuan reign (1108), at the price of thirty dollars.

In 1921, archaeologists from the National Historical Museum in Peking found at the Chü-lu site the remains of two houses, one belonging to a family named Wang and the other to a family named Tung. Some 200 objects of ceramic and other materials were found, including dishes and bowls set on a wooden table.

Wine jar, Chin dynasty, 12th-13th centuries. Tz'u-chou type ware. Indianapolis Museum of Art collection.

Another dwelling site at which many Tz'u-chou type wares have been discovered is Ch'ing-ho-hsien, which was inhabited in Sung and later times. But here no clearly dated material has been found.

Large numbers of Tz'u-chou type ceramic wares have been found in tombs across the northern part of China. They appear not to have been made specifically as funerary wares, but were just objects of daily use buried with the dead. Numerous objects were buried in a group of tombs excavated at Shih-chuang, Ching-hsing-hsien, Hopei province. In one of the tombs the remains of a man and woman were discovered with their heads resting on pillows of Tz'u-chou type ware decorated with stamped designs. The jars and bowls placed above their heads are also of Tz'u-chou type.

The ceramics industry in the North grew rapidly in the early part of the Sung period so that by the early eleventh century it was considered profitable enough to tap as a source of government revenue. A stele dated 1008 recording the appointment of a ceramics tax officer in Shansi province was found at a Tz'u-chou ware kiln site at Hung-shan-chen, Chieh-hsiu-hsien, in that province.

The kilns supplied not only an extensive market for household wares, but provided producers and distributors of regional wines and spirits with containers of many sizes and shapes. Jars inscribed with names of wines or wine shops, or with wine endorsements are known, and these must have been ordered by merchants at the local kilns. The Sung text, *Chiu-ming-chi* by Chang Neng-ch'en, a compilation of names of famous wines and wine shops, gives evidence of a large, flourishing wine and spirits industry. The text lists shops and brand names as well as the names of wines and the places where they were produced. Most of these places are in north China, many in the vicinity of kilns. The *Chiu-hsiao-shih*, or "Short History of Wine," by Sung Po-jen of the Yüan dynasty (1280-1368) also records names of wines and the places where they were produced.

An additional economic factor contributing to the development of Tz'u-chou type wares was the proximity of kilns to coal mines, on

Modern Tz'u-chou studio at P'eng-ch'eng-chen in Tz'u-hsien. Photo courtesy the Tz'u-hsien Cultural Bureau, Hopei province.

which they relied for fuel. The shortage of trees in the north brought coal into regular use as a fuel in the Northern Sung period. Coal was used for cooking in the capital, K'ai-feng, during the Northern Sung, and traces of coal ash have been found at kiln sites of Tz'u-chou type wares and also of Ting ware of the Sung dynasty. The essential materials of clay and running water seem to have been in good supply in the coal mining areas. In fact, clay was regularly found associated with deposits of coal, and it is recorded that fine clay always lay directly above and below the layer of coal.

Evidence of official patronage of Tz'u-chou type wares appears rather late in their development. None is known from the Sung period. In the Yüan dynasty pieces marked with the characters for "imperial repository" were made for court use. One of the kiln sites at which these official jars were ordered was Kuan-t'ai, where a black-glazed example was excavated. Others, with the inscription written in black on the white-slipped body, were found among Yuan remains in Peking.

By the Ming dynasty (1368-1644), official patronage of the Tz'u-chou kilns had reached more significant proportions. Ming texts record that the court ordered large numbers of wine jars of Tz'u-chou type. The *Ming-hui-tien* (a compilation of state regulations of the Ming dynasty) states that during the Hsüan-te period (1426-1435) 51,850 wine containers were ordered from Chün-chou, in Honan, and from Tz'u-chou and C'hü-yang-hsien, in Hopei each year. In the thirty-second year of the Chia-ching period (1553), also, large numbers of jars were ordered from these three areas. Because very few jars or vases of the Chün ware type are known today, it may be assumed that the wine jars from Chün-chou were also of Tz'u-chou type.

According to the *Shih-huo-chih* of the *Ming Shih* ("History of the Ming"), in the early part of the dynasty, the Prince of Chao's household ordered its sacrificial vessels from Tz'u-chou. The palace was situated not far away, in Chang-te-fu (modern day Anyang). The *Tz'u-chou-chih*, or "Gazetteer of Tz'u-chou," another source of information, records that in the twelfth year of the Hung-chih period (1498), 11,936 *p'ing-t'an* wine jars were paid to the government as

Left: *large wine jar, Ming dynasty, dated 1571. Royal Ontario Museum.* Right: *covered jar, Chin dynasty, 12th-13th centuries. Collection of Mr. and Mrs. Janos Szekeres, Stamford, Conn. Both pieces are Tz'u-chou type ware.*

tax. The buildings section of the same text mentions storehouses for official wine jars in the Tz'u-chou area during the Ming. One was located at Shih-ch'iao-tung, Nan-kuan, then moved to Liu-li-ts'un and finally back again to the original location Another official storehouse was in P'eng-ch'eng, in Fu-yüan. Each year the ceramic jars made for official use were collected and stored in these warehouses before being shipped by river to the capital. After the dynasty's end they fell into disuse.

Pillow, Northern Sung dynasty, late 11th-early 12th century. Tz'u-chou type ware. Field Museum collection.

The official patronage of Tz'u-chou kilns reached a peak in the Ming dynasty. Even at its highest level, however, the actual operation of the kilns appears to have been largely free of official interference. Throughout their development, the ceramics themselves continue to reflect popular rather then courtly taste.

The design and decoration of the wares are a lively testament to both the needs and the aspiration of the people, providing evidence of their material culture, of their appreciation of beauty, of their form of entertainment, their wishes for success, wealth and offering, and also of their moral and spiritual beliefs. □

Archaeology Around the Shores

by Kevin McGowan and Thomas J. Riley

photos courtesy of the authors

Like most days, this one begins before daybreak with a group of sluggish undergraduates gathered at a clearing along the lake shore. A mist rises from the water, foretelling another humid day. Towering trees and thick undergrowth hold back the first rays of sunlight that mark dawn. Perhaps in response to our noise, thousands of birds take flight to some other part of the lake in search of another day's food.

With considerable clatter the students unload from trailers the two boats that we have brought to the shore and carry them into the water. Finally, motors secured, equipment in place, the students don life jackets and board the tiny craft. The whine of outboards pierces the stillness of the morning and fish leap as our bow cuts the mirror of reflected sky and trees. Once again we begin our daily journey to the archaeological site that we are excavating on an island in the lake.

As we round a headland, an early morning wind has raised a chop that was not apparent when we embarked, and the smaller boat slows to avoid swamping. Soon, however, the site comes into view. In the distance it is easy to discern the form of the large dead tree killed by high lake waters and now covered by creeping vines. As we approach the terrace that we cleared some weeks before, the unmistakable signs of an archaeological excavation become apparent. Rectangular trenches and neat stringed squares are flanked by piles of sifted earth. About them stand wooden stakes that mark off the carefully measured grids. In a few minutes, trowelling, shovelling, and sifting will begin again. On every face is the anticipation that today's work will bring to light important clues to the prehistory of the area.

The foregoing narrative could be from an account of any of a hundred archaeological expeditions in the last fifty years—about a morning on the Nile River south of the Aswan Dam with archaeologists in search of the remains of ancient Egypt; or on Tonle Sap in Cambodia in search of Khmer settlements that supported Angkor Wat. It is there, in such exotic, remote regions that most people picture archaeologists at work. But the excitement of discovery and the adventure of coping with nature is common to all archaeological excavations no matter where they are located. In fact, we experienced these emotions while working on the prairie lands of central Illinois, near the town of Shelbyville.

This community of about 6,000 people, some 180 miles south of Chicago, has recently become a focal point for the U.S. Army Corps of Engineers' plan to manage the water resources of the Kaskaskia River Basin. This is achieved by regulating water flow through a dam on the river, where it passes near downtown Shelbyville. The dam has resulted in the formation of an 11,000-acre body of water — Lake Shelbyville — that cross-cuts Shelby and Moultrie counties.

The land that now surrounds or is covered by Lake Shelbyville has been of long-standing research interest to the Department of Anthropology at the University of Illinois Urbana-Champaign. Since 1960, faculty and graduate students there have sought to uncover more facts about the long cultural history in the Shelbyville area. The summer of 1982 saw the continuation of this research interest with one difference. Undergraduates were incorporated into the overall research program; students interested in learning about archaeological field and laboratory techniques were provided credit for participation in the program. The research work would also be in concert with the overall long-term design established by the university for examining Shelbyville's archaeological resources.

Last summer's program attracted twelve students — men and women — from a variety of backgrounds. We had two foreign students — from England and South Korea. The rest were from Illinois, some who had grown up in Chicago's inner city and some from rural communities. There was also a considerable age span—from 19 to the mid-40s. The result of this rather heterogeneous mix was an effective, harmonious work team.

Kevin McGowan is a graduate student in anthropology at the University of Illinois at Urbana-Champaign. Thomas J. Riley, an archaeologist and anthropologist, is associate dean of the Graduate College at that university.

Excavating at the Fultz site

The University of Illinois research interest in the Shelbyville area began with the authorization for a reservoir with the passage of the Flood Control Act in 1958. Survey and excavation began in 1960 as a result of the Reservoir Salvage Act of 1960, which provided for the recovery and preservation of historical and archaeological data that might be destroyed as a result of the construction of federally funded or licensed dams, reservoirs, and attendant facilities (McGimsey and Davis, 1977). Initial work in the area was funded by the National Park Service. The combined efforts of several researchers resulted in the identification of 62 archaeological sites.

These initial surveys were handicapped by limited funds, short field time, and poor ground visibility because of crop cover. It was estimated that only 40 percent of the reservoir was surveyed before impoundment of the water began in 1970. Unfortunately, the surveyed area excluded the southern half of the lake, leaving a sizable area archaeologically unknown.

The late sixties and early seventies proved to be a hiatus in the research efforts in Shelbyville, but federal concern for the resources continued to grow. A myriad of federal legislation and presidential orders directed federal agencies to take care of the archaeological resources within their jurisdiction.

But all the legislation in the world, of course, amounts to nothing if there is no enforcement. One caring individual, however, can sometimes suffice to push agencies into compliance with their mandated duties. In Shelbyville there were two such men: Environmental Officer Al Lookofsky and District Archaeologist Terry Norris, both of whom work for the U.S. Army Corps of Engineers, St. Louis District. Under their influence, contracts were reestablished with the University of Illinois with a design to develop a complete archaeological resource inventory of the lake.

The first step in this operation was carried out by Charles Moffat, then a university graduate student, who resurveyed the northern half of the lake. Moffat identified 61 new sites which had not been found by the earlier archaeologists. His research demonstrated the archaeological richness of this area and the adverse effects of lake erosion on the archaeological resources. His recommendations were to salvage several sites that were threatened with destruction by the lake waters but which gave surface indication of containing valuable archaeological information. He also emphasized the need to finish the resource inventory of the lake area.

Last summer our efforts were directed to the first of Moffat's recommendations: salvaging threatened sites. Our team excavated two sites known to have suffered damage due to the lake location, though the types of damage varied considerably. Our main interest was in the "Fultz" site (11-Mt-14), because the lake was eroding the site away. The second site was the "George Ward" site (11-Mt-5), affected because of

its unique location. At normal reservoir levels this site now appears as a large island in the new lake, and boaters have found it to be a convenient recreation spot. Unfortunately, the site had already been vandalized by souvenir hunters, and this illegal digging apparently destroyed most of the significant features contained there. Our interest in the site was to determine if sufficient valuable information remained to qualify it for nomination to the National Register for Historic Places.

We began excavation at the Fultz site during the second week of June, seeking evidence of settlements. Earlier research suggested we could find evidence for at least two different stages of settlement, one during the Middle Woodland period (300 B.C.-A.D. 500), and another during the Mississippian period (A.D. 900-1500). The earlier research also revealed prehistoric house foundations, a cemetery, and traces of old farming fields. We hoped we could uncover some of the foundations to help identify the people of the Kaskaskia River Valley and determine who their contacts were. House patterns can also give an indication of a settlement's size and suggest how many people were living there. But unfortunately, heavy rains had brought the lake to a higher than normal level, inundating both the village and burial areas and precluding any investigative work. However, we were able to recover important information from the large garbage pits these people had dug into the hard ground.

Garbage is like gold to an archaeologist. The materials that people discard can reveal much about their lifestyle. In garbage we can find evidence for the type of diet people were living on. A garbage heap is also the place where many broken household goods, like pottery and tools, end up. These remains of technological systems can be used to indicate relationships between different settlements, in one instant of time as well as across a period of time. We were able to excavate several of these trash pits before rising lake water forced us to abandon the Fultz site and explore our back-up site, the Ward site.

The island on which the Ward site is located is in the northern part of the reservoir about a mile from the Fultz site. We were immediately struck by the extent to which the large burial mound on the site had been vandalized; it resembled a small battlefield dotted with craters. The craters were surrounded by a jumble of decaying leaves, squirming millipedes, sandstone slabs, and human bone fragments. But in spite of the severe pot-hunting destruction, the site still contained much valuable information.

Our excavations into the mound were confined to a small area which had been most heavily vandalized. Here we recovered information on at least ten burials which showed very diverse interment practices. Some of the dead were in an extended body position similar to that in our own burial practice. Others lay on their side, in the fetal position. Some appeared not to have been buried right after death. These bodies had apparently been allowed to decay or

A Celebration of Birds

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by Robert McCracken Peck; introduction by Roger Tory Peterson
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were burned until all the flesh was off the skeleton. The bones were then apparently gathered up and buried as small bundles. There also is evidence in this mound that some bodies were cremated.

Among the burials we found a number of grave goods, including complete ceramic vessels as well as ceramic pieces which had, it seems, been intentionally shattered before the body was interred. We also found large stone knives. All of this information suggested that the site should be protected and placed on the National Historic Register. By excavating only the most severely disturbed areas it is hoped that some of the remaining burials can be allowed to rest undisturbed, protected from future intrusion.

Taking the information from the Fultz and Ward sites and from previous investigations around the lake, it is possible to paint a broad picture of Mississippian settlements in the Shelbyville area about 800 years ago. To do this one must visualize the landscape as it was before the lake was formed. The life of these Indians was focused near the muddy confluence of the Kaskaskia and West Okaw rivers. In the flats surrounding this junction they were able to till fields and grow corn. Having no plows or beasts of burden, they got along with digging sticks and hoes made from stone or shell.

In the surrounding forests and prairie they hunted deer and elk. The rivers provided fish and seasonal migratory waterfowl. They were also well acquainted with the potential of wild plant resources, some of which, like nuts, they could gather and store. With these resources they were able to establish relatively permanent villages near their fields. Some lived in homes built by setting posts around a rectangular pit (Moffat, 1979). These homes had cooking areas and storage pits for food or

The Fultz site was in constant danger of being eroded away by the waters of Lake Shelbyville.

Students drawing wall profiles at Fultz site.

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Nearly complete pottery vessel found with features at George Ward site.

tools. The dead were buried in cemeteries near the agricultural fields, or in one of the large burial mounds constructed on natural rises. At this time Indian settlers of the Shelbyville area appear to have been more closely tied to the Indians in the Embarrass River valley, less than 40 miles to the east, rather than to the large complex settlement of Cahokia, Illinois, to the south.

This scenario of Mississippian life along the middle Kaskaskia River is by no means complete, but we hope our ongoing research in this area will make the picture more substantial. In fact, it is the unknown aspects of past cultures which stimulate an archaeologist to go out and search for more pieces to the giant puzzle he works with. Each afternoon, as the archaeologist prepares to leave the field, he must consider the day's evidence—what does it say about the people who left it behind? The answers serve as guidelines for tomorrow's research. □

SUGGESTED READINGS

Illinois Archaeology:

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King, Thomas F. et. al.
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Shelbyville Archaeology:

Gardner, William
1969 "The Havana Cultural Tradition in the Upper Kaskaskia River Valley, Illinois"; Ph.D. Dissertation, Dept. of Anthropology, University of Illinois, Urbana.

Moffat, Charles R.
1979 "A Final Report of a Cultural Resource Survey of selected Portions of the Shelbyville Reservoir Shoreline Area"; Report submitted to the Army Corps of Engineers, St. Louis District.

Plants of the World Photography Competition 1983

The splendid exhibit "Plants of the World" will open at Field Museum on September 24. Over 400 plant models, constructed of glass, paraffin, and natural materials, ranging in size from a few millimeters to eight feet tall form the finest and most complete collection of such models in the world. The models are surrounded by five magnificent dioramas and thirteen large murals. Within this impressive setting the museum visitor will have a unique opportunity to learn about and experience the mysteries of plant life.

In celebration of flowers and the exhibit's opening, the Museum announces the Plants of the World Photography Competition. For this event, all members who are photographers (regardless of residence) as well as nonmember photographers in the Chicago metropolitan area are encouraged to submit slides of flowers and plants without any further restrictions on subject matter—any subject in the realm of the plant kingdom is acceptable. The competition is divided into two age groups: Group I entrants must be under 17 years old as of August 1, 1983; Group II entrants must be 17 years or older as of August 1, 1983.

To enter, follow instructions and complete the form below. Slides must not be mounted in glass. Only original slides taken by the entrant that have not previously been published are acceptable. Indicate the proper slide orientation for projection with a dot in the upper right corner of the mounting on the non-emulsion side, together with your name and slide title.

Please make your check payable to Field Museum.

Delivery

Entries will be accepted between August 1 and August 15, 1983. Mail to:

Field Museum Photography Competition
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605

Please pack entries *with care*. Field Museum assumes no responsibility for damage or loss in shipment, delivery, and/or return.

Returns

Enclose a suitable self-addressed, stamped envelope for return of the entries. Entries that are not so accompanied will be discarded. Field Museum assumes no responsibility for damage or loss in return mail.

Awards

- Grand Prize: Reproduction of the winning entry as the front cover illustration of the October 1983 Field Museum *Bulletin*.
- First, Second, and Third Awards of Merit Group I and II: to be reproduced in the October Museum *Bulletin*.
- Six Honorable Mentions.
- Certificates of Selection.
- The prizes that will be offered will be announced in the June *Bulletin*.

Award-winning photographs will be on exhibition in Gallery Nine for the opening days of the Plants of the World exhibit, September 24 to October 9, 1983. The Museum reserves the right to publish, exhibit, and use for promotion the winning photographs. The decision of the judges is final.

Eligibility

Competition is open to photographers in the Chicago metropolitan area (Cook, Lake, McHenry, Kane, DuPage, and Will counties) and *all* museum members. Employees of Field Museum and the cosponsor and their immediate families are not eligible.

Entries

A completed entry form and entry fee of $5.00 must accompany each entry of one to three 35mm color slides. Entrants may submit three entries of 1 to 3 slides each (a maximum of 9 slides for the contest).

Entry forms are also available at Field Museum's Information Desk. The form may be photocopied for additional entries.

Join us in this celebration of flowers and photography.

Entry Form: Plants of the World Photography Competition

This form must accompany all entries. Use the guidelines above as a checklist.

Name_____ Daytime phone_____

Address_____
street

_____
City State Zip Code

Group I____ Group II____

Enclose $5.00 check or money order payable to Field Museum of Natural History.

I understand and agree to the conditions of the contest as stated in the above guidelines.

Signature: _____ Date: _____

Members' Night May 19 & 20

FIELD MUSEUM OF NATURAL HISTORY BULLETIN

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COVER

A 15th-century Inca wooden llama head in the Field Museum collection from the imperial capital of Cuzco. Human populations in the Andes rely heavily on the llama as a source of wool, and meat and as an important pack animal. Field Museum personnel are presently conducting extensive archaeological research in the Southern Peruvian Andes. (See pages 6-17.) Photo by Fleur Hales.

VOLUNTEER OPPORTUNITIES: The Place for Wonder offers qualified volunteers an opportunity to share their knowledge of natural history with youngsters. Weekday volunteers are also needed in Botany, Geology and Zoology. Contact the Volunteer Coordinator at 922-9410, x360 for information.

Events

Special Events

"Reel Life: Film as Art vs. Film as Documentation"
Saturday, June11, 10:00am-5:00pm
James Simpson Theatre

Ethnographic films describe the behavior of different cultures. This type of film is as old as cinema itself. Many of these films are considered landmarks of documentary filming and valuable records of native peoples, but are they? Do these films portray the "truth" about a culture or are they the personalized and artistic vision of the filmmaker?

Join us for a fascinating day of film and commentary. The program begins with "The Shadow Catcher," the life and work of Edward S. Curtis, followed by "In the Land of the War Canoes." Then Dr. Paul Hockings comments on the issue of film as art vs. film as documentation at 1:00pm. The afternoon screenings feature "Jaguar" by Jean Rouch and "Moana of the South Seas" by Robert Flaherty. A complete schedule follows.

10:00am	"The Shadow Catcher" (88m)
11:30am	"In the Land of the War Canoes" (44m) Edward S. Curtis
1:00pm	"How Do Anthropology Films Handle Reality," with Dr. Paul Hockings, Dept. of Anthropology, University of Illinois, Chicago
1:30pm	"Culloden" (72m) Peter Watkins
2:45pm	"Jaguar" (93m) Jean Rouch
4:20pm	"Moana of the South Seas" (85m) Robert Flaherty

These films are free with Museum admission and tickets are not required.

Summer Fun 1983

Children ages 4-12 are invited to explore Field Museum's collections in a series of exciting workshops beginning July 5. Explore the world of Tibetan legends, find out how paleontologists reconstruct a dinosaur, see how temple dancers perform in India, learn the newest archaeological field methods, and make your own scientific illustration of a botanic specimen. Anthropologists, zoologists, archaeologists, artists, dancers, and filmmakers bring their talent and expertise to create new, informative and creative experiences.

Enrollment for these workshops is limited and advance registration must be done by mail. Call (312) 322-8854, Monday through Friday, for up-to-date information about Summer Fun.

Highlights

"Creepy Features"
Saturday and Sunday
June 18 and 19, 1:00 pm
Hall 18

Join us for fun films about bugs, beetles, and butterflies followed by "Bug Hunt," a do-it-yourself whodunit. The films and "Bug Hunt" performance are free with Museum admission. Tickets are not required.

1:00pm, "The Beekeeper" (14m) In this wonderfully straightforward documentary an engaging young man explains his unusual job as a beekeeper.

1:15pm, "Nature Morte aux Fruits" (2m) Utilizing cut-out animation, this film is an irreverent study of an 18th-century Neapolitan still life in which the agents of nature (caterpillars, butterflies, and larvae) consume the models (fruit, wine, and oysters.)

1:20pm, "The Presence" (3m) Stan Brakhage examines the world of insects from the point of view of a beetle. This is an experimental film with wonderful close-ups of the beetle.

1:25pm, "Don't" (19m) A "perils of Pauline" format dramatizes the life cycle of a monarch butterfly.

Bug Hunt:" A Do-It-Yourself Whodunit"
Saturday and Sunday, June 18 and 19, 2:00 pm
Hall 18

Children and their parents are invited to help in the investigation of a mystery! A monarch caterpillar has disappeared from a local garden. Her friends Lottie Ladybug, Bernice Bee, and Gullible Grasshopper have hired a top-notch "gumshoe" to solve the case. Participate in the drama as a cast of insect characters follow the clues of the "missing monarch."

Weekend Programs

Each Saturday and Sunday you are invited to explore the world of natural history at Field Museum. Free discovery tours, demonstrations, and films related to ongoing exhibits at the Museum are designed for families and adults. Check the Weekend "Passport" upon arrival for the complete schedule and program locations. These programs are partially supported by a grant from the Illinois Arts Council.

June

4	1:30pm	*Eskimos: Hunters of the North*, tour
5	12:30pm	*Museum Safari*, tour
	2:00pm	*Masks, Boxes, and Bowls*, slide lecture
11	1:30pm	*Tibet Today*, slide lecture/tour
	2:30pm	*From Catlin to Curtis*, slide lecture/tour
12	2:00pm	*Chinese Ceramic Traditions*, tour
18	2:30pm	*Curtis' Vanishing People*, slide lecture
19	12:30pm	*Museum Safari*, tour
	1:00pm	*Treasures from the Totem Forest*, tour
	2:30pm	*Film Feature:* "Audubon" (50m)
25	11:00am	*Ancient Egypt*, tour
	1:30pm	*Tibet Today*, slide lecture/tour
26	12:00	*Life in Ancient Egypt*, tour

Registration

Please complete coupon for your program selection and any other special events. Complete all requested information on the application and include section number where appropriate. If your request is received less than one week before program, tickets will be held in your name at West Entrance box office until one-half hour before event. Please make checks payable to Field Museum. Tickets will be mailed on receipt of check. Refunds will be made only if program is sold out.

Program Title	Member Tickets #Requested	Nonmember Tickets #Requested	Total Tickets #Requested	Amount Enclosed
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Archaeological Reconnaissance in Southern Peru

by CHARLES STANISH and IRENE PRITZKER

Field Museum Continues Participation in Joint U.S.-Peruvian Research into Far-Flung Corners of Inca Empire

photos by Robert Feldman except where indicated

Five centuries ago the imperial armies of the Incas marched—and opened up a new chapter in world history. Tahuantinsuyu, or the "Land of the Four Quarters," as the empire was called, controlled, at the height of its power, as many as 84 distinct provinces stretching 4,300 km over some of the most rugged terrain in the world. In the brief period of 97 years, the Incas welded dozens of ethnic groups and independent "nations" into a single political system that rivalled the Roman Empire. Like the Roman Empire, the success of Tahuantinsuyu lay not only in Inca military might, but in its administrative capacity to integrate these widely disparate peoples into a single political and economic system.

One of the most enigmatic corners of this amazing realm is an area in the southwest of Peru called by the Incas Contisuyu, or "Land of the Setting Sun." Within the boundaries of Contisuyu is the modern Moquegua Valley, known today, and in the fifteenth century, for its rich agricultural produce. For years, archaeologists and historians have suspected that Moquegua contained enormous research potential, but problems of

Above photo: The towering massif of Cerro Baul dominates the upper Moquegua Valley. This impregnable natural fortress was the site of pre-Hispanic towns dating to at least A.D. 600.

Charles Stanish is a doctoral candidate in the Department of Anthropology, University of Chicago. Irene Pritzker is a coordinator of the Constisuyu Program.

funding and organization prevented any scientific investigations until the successful launching last year of Programa Contisuyu.

Programa Contisuyu is a coordinated effort by Field Museum and the Peruvian Health Sciences Museum to research, conserve, and develop the antiquities and heritage of the Moquegua Valley. U.S. businessmen sponsored this cooperative scientific effort because they were concerned that their mining and industrial development was exposing a rich, but unstudied cultural and natural heritage. In the January 1982 *Bulletin* we described the formation and goals of Programa Contisuyu, and we are pleased to report that the program is now supporting systematic archaeological surveys of the region. Here we summarize the first important results of these surveys conducted by Charles Stanish.

Until now, we had no real idea of the nature and extent of Inca rule in Moquegua, although several early Spanish documents mentioned the valley as a major maize-producing zone for the Lake Titicaca region to the northeast. Now, for the first time, we can begin to sift fact from fiction. It seems that the Inca incorporated the Moquegua region in order to expand the tax base of their empire. All taxes were paid in two principal types of labor: agricultural work on state and church fields, and *mita*—work by males on state construction projects, such as building agricultural terraces, roads, or new towns. Thus, to incorporate the people of Moquegua within their empire, the Incas had to mastermind a massive reorganization so that labor taxes could be paid and the agricultural yields produced could be directed toward state and church ends.

Our survey began at the hilltop "fortress" believed to be the initial site besieged by the Inca armies. This is the great natural massif of Cerro Baul, termed by our project the "Masada of the Andes," since chroniclers report that it was to its safety that the native inhabitants retreated before they were finally suppressed by the Inca. The sprawling ruins have never really been documented, and although locals believe them to be the remains of the besieged town that the Inca chroniclers described, the scattered sherds of painted pottery among the masonry foundations indicate that most of the buildings were erected in conjunction with a much earlier culture that had occupied the valley. At best, Cerro Baul was only a strategic retreat when the valley's population briefly defied the might of the Inca.

Members of the Proyecto Contisuyu staff examine a pit dug by treasure hunters. A goal of the project is to prevent such damage in the future through public participation in preserving Moquegua's past.

Grinding slab used to process maize, or Indian corn. These artifacts are found scattered throughout the archaeological sites in Moquegua.

THE NEW ORDER

There was no evidence that the great mesa was occupied at all after it was incorporated within Tahuantin-

suyu; it was apparently, and sensibly, not Inca policy to leave newly conquered subjects occupying forts and strategic settings from which rebellion might spread, or from where it might prove difficult to extract the labor taxes. Our survey and mapping activities confirm what is known to be a general Inca policy of resettling people in agriculturally productive areas. As we mentioned, we believe that the crown claimed title to all land, dividing it into three estates: church, state, and government land. In virtually all cases the Inca built an impressive town designed to house the provincial officials, collect taxes, garrison troops, and provide lodging for visiting dignitaries.

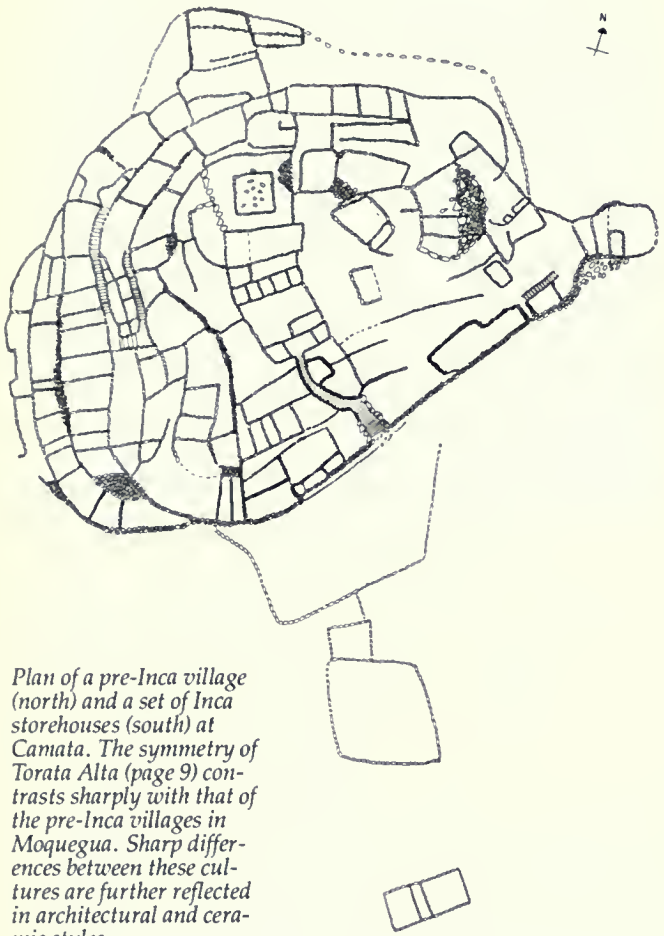
Inca chronicler Garcilasco de la Vega relates that imperial authorities established two new towns or cities in the area we mapped. One, called Cuchuna, was near the base of Cerro Baul; the other, called Moquehua, was twelve miles away. It was from the latter that the modern city and the Moquegua region derive their names. Garcilaso's accounts are not always reli-

View of the upper Moquegua Valley. Terrace systems built centuries ago continue to provide a rich agricultural base for the region.

The Moquegua puna, or high sierra, where several Inca period sites were found. Shown here is a recently abandoned farmstead built over the ruins of the Inca settlement.

Plan of the Inca administrative center at Torata Alta. The Inca nobility probably controlled the affairs of the Tarata province from this site.

able, and we have not, as yet, been able to locate ancient Moquehua. It may well lie under the modern city, or Garcilaso may have confused or embellished his story. A likely candidate for Cuchuna is situated above the present village of Torata on a low wide hill about 10 km from the base of Cerro Baul. The site includes a village of local people and a nearby complex of impressive masonry buildings built in a radically different architectural style. This complex, known as Torata Alta, or "High Torata," shows clear evidence of Inca town planning with uniform, straight streets running in a large grid pattern, reminiscent of a Roman imperial military settlement. In fact, the gridlike layout of Torata Alta is rather similar to early Spanish towns, but in mapping the many buildings we found only distinctive Inca pottery, suggesting that the site was probably a small administrative center in the elaborate Inca hierarchy.



Plan of a pre-Inca village (north) and a set of Inca storehouses (south) at Camata. The symmetry of Torata Alta (page 9) contrasts sharply with that of the pre-Inca villages in Moquegua. Sharp differences between these cultures are further reflected in architectural and ceramic styles.

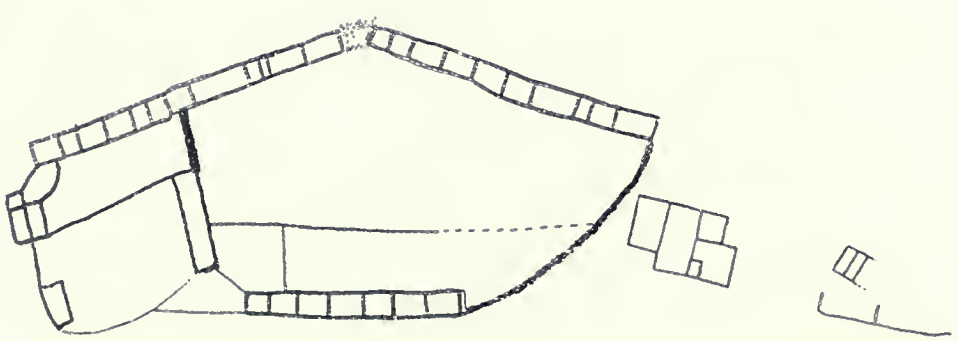
The western half of the new town shows the greatest architectural uniformity. There are fourteen rectangular courts, delineated by streets and containing structures that could have served to store maize, root crops, tubers, and other tax products collected from the surrounding agricultural area.

In the north-central section of Torata Alta, a modern soccer field occupies what may have been the main plaza of the complex. Plazas in Inca administrative centers such as Torata Alta had several functions, including public ceremonies which promulgated and displayed Inca authority as well as activities which related to the inspection of agricultural yields that were either stored locally, or were transported along the royal highway system to other locations. In this connection it is significant that the principal street of the present town runs adjacent to the main plaza and exits out of the site onto a major ancient road; the latter runs through the surrounding terraced fields as it ascends the mountains.

The southeast portion of Torata Alta has buildings with the least formal layout. This suggests that it was the principal residential area of the local officials and administrators. In recent years, treasure hunters have dug into the rooms and courts, unfortunately exposing ancient refuse and midden remains.

In the south-central sector of the present town there are remains of at least 16 small round structures identified as *chulpas*—burial towers where people of distinction were interred. In the mountains northeast

1 inch = 38 meters



of Moquegua, the Inca and their subjects built beautiful mortuary towers of finely cut rock several stories high. In contrast, the *chulpas* of Torata Alta, which were looted long ago, are low and small, about 1.5 m in diameter and only about 1 m high in their tumbled-down state. This supports descriptions by Inca chroniclers that while Torata Alta was the major administrative node in Moquegua, it was subservient to a larger hierarchy of more powerful centers.

The Inca incorporation of Contisuyu required not only the management of people and labor, which Torata Alta was designed to handle, but management of the agricultural fruits of their labor. From previous explorations in other quarters of Tahuantinsuyu, we know that mita labor was used to build warehousing complexes on the hillsides near administrative centers. In our summer of explorations, we located and mapped a magnificent complex of storehouses high above Torata Alta on Cerro Camata, approximately 10 km away. The suffix *kamach* means "govern," or "order." In the southern Andes there are several site names incorporating *camata*, and there is good reason to suspect that Camata, like Moquegua, might have been the original name of a location used by the Inca themselves or by their local subjects.

The well preserved Camata storehouses are built in typical Inca architectural pattern and comprise banks of contiguous rooms measuring about 5 × 5 m each and laid out in several rows. The walls are constructed of local, uncut stones, set in adobe mortar, and although the thatch roofing is gone, the walls still stand higher than a man's head. The rooms were entered through the roof by means of projecting stones that were built into the walls so they could serve as steps. To keep the agricultural produce fresh, small rectangular ventilator openings were built into the base of the walls. There are three rows of storehouses at Camata, and by conservatively estimating the maximum height of the walls at 2 m the total potential storage capacity of the complex was on the order of 700 cubic meters of agricultural produce. The storehouse rows are arranged around a small plaza that, reminis-

A single Inca storehouse, typical of those described at the Camata site. It is thought that these storehouses were used to keep grain and other produce before being transported to other Inca settlements or collected by the Inca government.

Charles Stanish

cent of the Torata Alta main plaza, connects with a major Inca highway.

Other smaller storage facilities are found along the road as it ascends the hills from Camata. There is a scattering of nearby *chulpas* and some well-made office or residential buildings that probably served officials concerned with management of the warehouse complex. Several kilometers to the east on the Inca royal highway is another set of storage facilities, also associated with massive terraced fields.

These storage sites may represent the most important feature in the economic oganization of Moquegua. We know that well before Cuzco was anything more than a small village, people from the high Lake Titicaca region in Bolivia maintained settlements or "colonies" in the valley in order to exploit the lowland climate and rich soils. Here could be grown maize, coca, and a variety of important crops that could not stand the nightly frosts in the mountains. These people built a large and expansive state known as Tiwanaku (See the September 1982 *Bulletin.*) In particular, the Tiwanaku state was interested in Indian corn, or maize. Maize was not only an important component of the Andean diet, but had ritual uses and was also fermented into a popular beverage known as *chicha* beer.

After the collapse of Tiwanaku and the abandonment of highland settlement in Moquegua, we suspect that these economic links were continued on a less formal basis. Ethnohistoric documents from the sixteenth century describe Lupaqan lords from the Titicaca region (a small pre-Inca kingdom that continued to exist as a vassal state of Tahuantinsuyu), as sending caravans of llamas loaded with highland goods, such as potatoes, to exchange for maize and marine products from the valleys and coast.

When the Inca conquered the Titicaca basin, it was apparently necessary to continue these economic links with the Moquegua valley. The construction of the terraces and storehouses at Camata represent the reimposition of formalized, state-level control over the maize fields in the valley in a manner that was probably not unlike that found earlier during the florescence of Tiwanaku.

Based on this hypothesis that the Inca maintained this exchange route between the altiplano (the highland grassland and the country where the Titicaca basin is located), we set out to see if any intermediate sites could be found. Thanks to an incredible piece of archaeological luck, in less than two days we found three very small Inca sites high in the mountains above the alpine limits of agriculture, near Lake Suches, a beautiful body of fresh cold water at 4,300 m above sea level. This is wild and rugged llama-herding country, with the most unique, savage, and magnificent scenery imaginable. Today it is almost uninhabited.

Stone llama head from Cuzco carved for the Inca nobility. Such artifacts were used for ritual purposes and were probably introduced into Moquegua at the time of the Inca conquest a century or two before the arrival of the Spanish.

The three small sites did not have the complex architecture of the valley sites, but we did find, scattered on the surface, pieces of unmistakable Inca, or Cuzco-inspired pottery, which was similar to that found in the Moquegua Valley. We also found exposed ash and garbage remains that indicated to us that the sites were small residences of some sort. Our luck continued as we found a 1947 report by the Swedish archaeologist Stig Rydén, who described virtually identical pottery on Inca sites near the *Tiwanaku* area.

The most distinctive ceramic design is that of a delicately stylized llama painted on the inside of plates. This is a common motif found throughout the altiplano but not as yet found in the valley. Other ceramics however, were common to both the Lake Suches sites and the Moquegua valley towns.

Lake Suches may therefore lie on an important pre-Hispanic transport route between Moquegua and Lake Titicaca, which is situated on the border of Peru and Bolivia. Alternatively, these sites could have served as the houses of those tending flocks of llama and alpaca for the Inca state. It is also likely that the Suches sites functioned in both capacities. This we will not fully understand until we conduct future excavations. What we have done in just this preliminary season of work is to show a probable connection between the Moquegua Valley and Lake Titicaca.

A major methodological problem in defining the nature of the Inca expansion and administration in the valley is simply distinguishing Inca from non-Incas.

Archaeological work of Contisuyu Program sheds new light on Incan Empire—the New World's counterpart, in significant ways, of ancient Rome

A historic period hacienda near Torata built in a typical Spanish colonial style. After the Spanish conquest, Moquegua continued to be a major agricultural and wine producing area.

Fortunately, the problem is controlled by the dramatic contrast between indigenous and Cuzco-inspired architectural and ceramic styles. Both Camata and Torata Alta are located within 500 m of major pre-Inca or contemporary local villages. In both villages we see the stark architectural contrast of curvilinear walls and rooms built on terraces conforming to the general topographic contours of the natural hill. The series of passageways, perimeter walls, and controlled access to the interior of the sites reflect defensive or military considerations which are wholly absent in the Inca towns.

NEW EXPLORATIONS

We have yet to explore or map a myriad of Inca installations that the conquest and reorganization of the Moquegua region brought about. But it has become quite clear to us that the imposition of a new political and economic order required a hierarchy of state-founded settlements which ranged from the magnificent administrative complex at Torata Alta, through the warehouses of Camata, to the herding or way stations at Lake Suches. From flights over the more remote sections of the Moquegua Basin we know that many other architectural monuments exist and remain to be integrated into our understanding of the Inca administration.

An area of immediate concern is with the most ubiquitous of all the local ancient monuments: the *andenes*, or the vast systems of abandoned agricultural terraces from which the Andes derive their name. Torata Alta is surrounded by these masonry-faced struc-

Inca ceramics such as the famous aryballoid vase (opposite page, top) and the serving plate (opposite page, bottom) contrast with the brightly colored pre-Inca Chiribaya polychromes (this page). These differences in material remains help us identify the age and cultural affiliation of the numerous archaeological sites in the valley.

The Moquegua valley, as seen from the Inca town of Torata Alta. The modern town of Torata rests in the foothills of this important Inca site.

tures; Camata sits atop them, and the Inca highway system crosses countless kilometers of once fertile farmland reclaimed by *andenes*.

While the discrimination between Inca and non-Inca sites is a relatively simple task, the ability to distinguish between Inca and non-Inca terrace-canal-field systems is much more difficult. It is critical that we be able to make this distinction for the following reason: We know that the basis of the Inca economy was the *mita* labor tax system and that it was principally applied to agriculture and agro-engineering constructions, but if we hope to understand anything about the economic impact of the Inca occupation and the process of imperial administration, it is vital that we can clearly determine the agricultural systems created by, and worked for the Inca hierarchy.

Our surveys show that the terraces were built in a pattern of segmented walls, which probably reflects *mita* work units, and the Inca seem to have wisely invested labor taxes in making the rugged landscape more bountiful. Yet, why are they no longer farmed? Abandoned *andenes* encompass at least 30 percent more land than are farmed today in the same region. Reactivated, they would have a very significant economic impact. Yet, before this can be pursued we must unravel the subtle mystery of why they were abandoned; otherwise, reactivation might simply lead to making the same mistake twice. The necessary field research, which will begin this year, involves the endeavors of botanists, geologists, hydrologists, engineers, and archaeologists.

To this end, the resources of Field Museum are indispensable. Utilizing the Museum's computer system, we will be able to apply a complex multivariate statistical technique to the various terrace systems in the valley. By measuring a number of variables, such as slope, height, terrace area, etc., we can mathematically distinguish between different sets of agricultural systems that otherwise would be indistinguishable by qualitative examination.

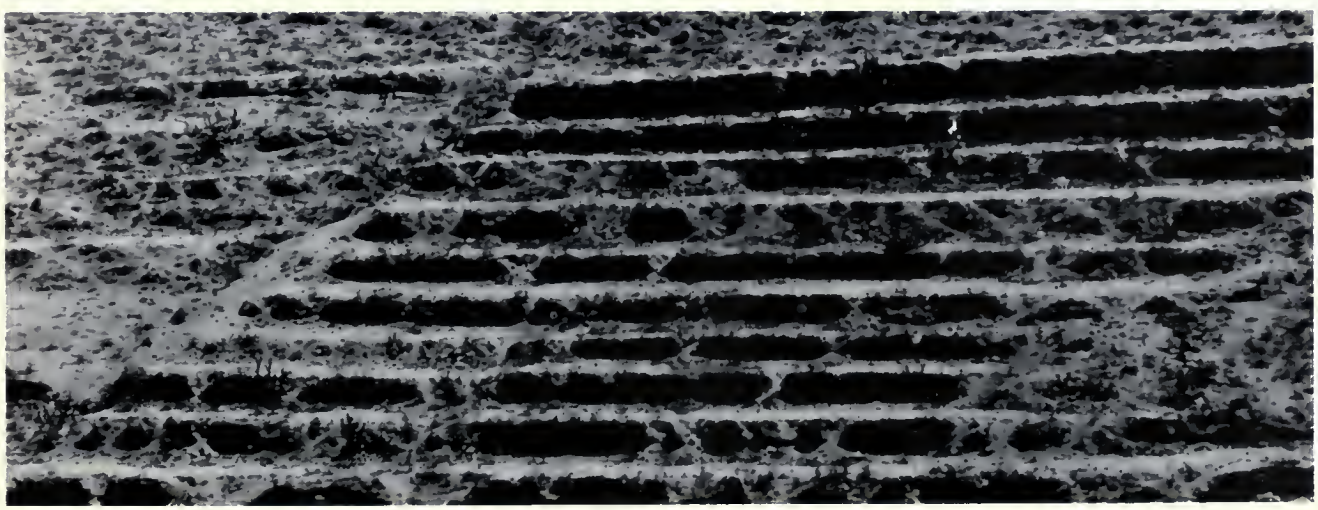
These mathematically distinct groups of terrace characteristics will, we hope, reflect differences in construction technique and engineering expertise which should have existed between the Inca agricultural engineers and their local counterparts. Likewise, the analysis of high-altitude photographs to define Inca road systems and canals should help pinpoint those agricultural systems built and operated by the Inca administration.

Our preliminary survey of last summer has raised far more questions than we have been able to answer, but we hope that future research in Contisuyu will aid a thorough understanding of Inca period settlement and agricultural land use. Through the mechanism of Programa Contisuyu, we hope to be able to provide a firm anthropological data base which can be used for modern agricultural expansion.

This will be feasible, and perhaps more successful than previous attempts, because we will understand not only the mechanics of pre-Hispanic agriculture, but the social, demographic, and political concomitants of this complex system—factors which have been largely ignored by agricultural planners and governmental agencies seeking to rejuvenate the ancient systems. Past failures of multimillion dollar land reclamation and land reform projects throughout the developing world has been due, in part, to an inadequate understanding of these social parameters.

Now that Programa Contisuyu is an established ongoing program, future research prospects are exciting. This year we expect to discover new sites which will augment our current body of knowledge of the extent and influence of the Inca empire. □

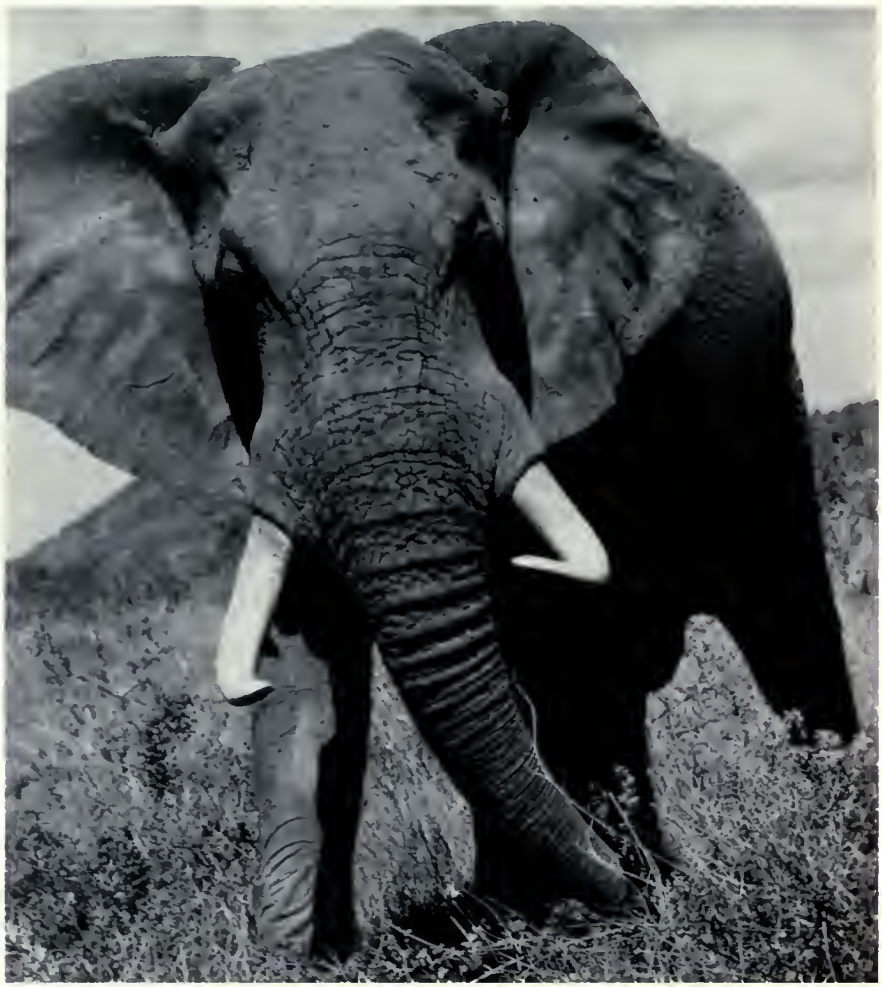
Abandoned terraces dominate much of Moquegua's landscape. Years of disuse have led to their severe erosion and damage. A goal of Proyecto Contisuyu is to assess the feasibility of rejuvenating some of these agricultural systems for the betterment of all Perú.



TOURS FOR MEMBERS

Costa Rica Tour

January 14-27, 1984
Leader: Dr. William Burger,
Chairman of Field Museum's
Department of Botany



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Seychelles Extension $1,350
September 10-28

A really exciting adventurous and in-depth safari carefully planned under the expert guidance of our leader, Audrey Faden This is the third consecutive year Audrey has led this tour for Field Museum She is a former staffer of the National Museum of Kenya and her keen interest in wildlife, conservation, and plant life make her a natural to lead our tour If you have an inquisitive mind and would like to learn about the wildlife, ecology, and plant life, this safari should be your choice. Photography will be a major objective on this tour and our specially equipped safari vehicles will provide clear visibility for all participants.

TOURS FOR MEMBERS

The unique itinerary of this tour, rarely granted by the Chinese authorities, includes the most significant sites of early Imperial China and will give an opportunity to explore in depth the civilization which characterizes one of the earth's longest-lived societies. At a small additional cost, you may remain longer in Japan at completion of the China tour. Tour leader is Mr. Phillip H. Woodruff, Ph.D. candidate in Chinese history at the University of Chicago. This is Mr. Woodruff's 4th time as a Field Museum China tour leader.

Itinerary

October 6: Mid-day departure via Japan Airlines on a direct flight to Tokyo's New International Airport (Narita).

October 7: Afternoon arrival. Transfer by private bus to the New Takanawa Hotel in downtown Tokyo (15 minutes by car to the Ginza).

October 8: Morning at leisure for individual options. Afternoon city tour to see Tokyo's treasures.

October 9: Morning transfer by private bus to Narita airport. Depart from Tokyo for Beijing (Peking). Short meeting with representative of China International Travel Service on arrival.

October 9-27: In China. The only flight scheduled on our itinerary in China is from Beijing to Xian (Sian); the other transfers between cities will be via train. China's train schedules are more reliable than the air schedules, and you get the additional opportunity to see more of the countryside.

The following is our anticipated schedule:

October 9: Enter Beijing (side trip to the Great Wall and the Ming Tombs); October 12: Flight to Xian; October 15: Luoyang (side trip to Longmen caves); October 17: Zhengzhou; October 20: Kaifeng; October 22: Suzhou (overnight train ride); October 24: Shanghai.

October 27: Depart Shanghai by air for flight to Tokyo. Overnight at Nikko Narita Hotel (near airport). Dinner at the hotel.

October 28: Day in Narita at leisure; breakfast at the hotel is included. The city of Narita is very lovely and interesting, and you may wish to visit the downtown area. The hotel affords a lovely garden area with a snack bar and an outdoor swimming pool for relaxing.

Early evening flight (6:00 p.m.) via Japan Airlines for Chicago, arriving in Chicago at 5:15 p.m. (When we cross the International Date Line, we regain the day we "lost" en route, thus arriving in Chicago before we left Tokyo!)

For further information on any tour, please call Dorothy Roder at 322-8862 or write Field Museum Tours.

Ecological Studies of Tropical Cicadas

by ALLEN M. YOUNG

Cicadas are robust, plant-sucking insects belonging to the order Homoptera; among their closest relatives are the aphids, leafhoppers, and mealybugs. Many species are well known in North America for the summertime habit of males chorusing in the treetops.

Working in the garden during midsummer in the Midwest one may often come upon the large, discarded exoskeleton, or husk, of the cicada nymph—the immature, or growing, phase. The cast-off husks still cling to the leaves and branches of shrubs, to tree trunks and to fences. The female, which lives for a few weeks, makes a tiny slit in the bark of a branch and deposits her eggs there. After hatching, the young nymphs drop to the ground and burrow into the soil, where they feed on sap from plant roots, using a stylet-like beak.

Depending on the species, the nymph stage may last anywhere from three to twenty years, which poses a difficulty for researchers interested in making repeated censuses of cicada populations. Yet, some of the most thorough research on cicadas has dealt with the North American periodical cicadas, the so-called "13-year" and "17-year" cicadas.[1] Among the most distinguished investigators of these were two former Field Museum staff members: the late Henry Dybas, former curator of insects, and the late D. Dwight Davis, former curator of vertebrate anatomy (whose research interests ranged well beyond his prescribed areas).

Newly emerged adult cicada with husk.

91003-A

Unlike most other cicadas, the periodicals not only have long life cycles, they also emerge in population densities which far exceed those of most nonperiodical species. The periodicals have synchronized adult hatches in a given region or regions, and adults of any particular species are generally absent for most of the intervening

1. *In many areas cicadas are commonly called locusts, a term more properly applied to certain grasshoppers.*
2. *The next major emergence of 17-year cicadas in the Chicago area will take place in late May and early June of 1990. Just east of Chicago, throughout most of Indiana, western Ohio, and southernmost Michigan, a separate brood is scheduled to make its appearance in 1987.*

Allen M. Young is curator and head of the Invertebrate Zoology Section of the Milwaukee Public Museum.

years between emergences. It has been proposed that huge mass emergences of cicadas at intervals of many years is a mechanism by which cicadas satiate their predators and thus are able to survive in greater numbers.[2]

Excepting a few species that are pests of sugar cane plantations and have come under scrutiny for obvious economic reasons, far less is known about tropical than about temperate region cicadas. But in Costa Rica (the size of Vermont and New Hampshire combined) there are far more genera and species of cicadas than in all the United States east of the Mississippi. Periodical cicadas with life cycles of 13 or 17 years apparently do not occur in Costa Rica, nor on the other hand do they all seem to be annual; some, I suspect, have cycles of 3 to 5 years.

With National Science Foundation grants I had the opportunity to study the cicada fauna of Costa Rica for five years, identifying nearly thirty species in the northern half of that tiny country. Even within small areas of tropical rain forest I was able to find several genera and species of these insects active at different times of the year.

With assistance from Lawrence University students (Appleton, Wisconsin), I censused cicada populations during the five-year period in a broad transect from the coastal Caribbean lowlands, into montane rain forests, through montane river gorges and coffee plantations, and into the deciduous dry forests of the coastal Pacific region. We censused the number of species in each locality and noted the timing of seasonal emergences. We also investigated emergence locations in particular sites,

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Above: *A portion of Field Museum's cicada exhibit, showing diversity of forms.* Below: *Mounted cicada specimens, with adults above and nymph husks below.*

noting whether nymphal husks were spread more or less evenly over large areas or whether they were clumped in small areas around certain tree species.

I early found that the husks of different species could easily be identified on the basis of size, shape, color pattern, and prominent structures such as those on dorsal thoracic, or "back," areas. The nymphal husk is nearly a replica of the adult, except for the absence of fully developed wings. During their long development period underground, cicada nymphs molt many times in cells or chambers, but the final molt with the fully formed adult emerging, is aboveground. So the researcher who is sampling populations can do this with relative ease by counting discarded husks at regular intervals throughout the year and over a succession of years. The husks, which persist for several months before decomposing, provide an accurate record of hatches.

Within each of a dozen or so forest sites in the transect, I marked off quadrat plots and collected all cicada husks in them over the five-year period, choosing habitats where I observed adult cicadas in trees. Quadrats were selected for the most part at random, but with some consideration for sites with a variety of tree species large enough to have canopies.

Since the area of my study had considerable altitude variations—from 30 to 1,300 meters, I found differences in the cicada fauna according to elevation and habitat. Differences in distribution are also related to ecological conditions such as availability of resources, past biogeographical events, and man's recent impact on tropical forests. Lowland and mid-elevation (so-called premontane) tropical rain forest sites, I found, supported many more genera and species of cicadas than the lowland tropical dry forest, and also produced more species than occur in agricultural zones such as coffee plantations. The greatest range in cicada body size occurs in lowland and premontane tropical rain forest. Members of a few genera are as small as 10 mm (4/10 inch) long, others as long as 60 mm (about 2 3/8 inches).

Much of the highland landscape of Costa Rica and other parts of Central America is an expanding patchwork of gulley forests and grazing pastures. Cicada populations in such places become largely restricted to forest "islands."

Allen M. Young

Allen M. Young

The rain forest cicada Fidicina spinocosta *gives off a shrill whistle-like call at dusk in Costa Rica. It is most commonly encountered in dense second-growth forest, where the adults are well concealed by the foliage.*

At any single locality, I found that peak adult emergence periods occur annually for different species. In areas where the seasons are distinct, some species hatch mostly in the long dry season while other species emerge in the rainy season. The pattern is much the same in the semimoist highland forests and in coffee-growing areas. But in the lowland and foothill tropical rain forest zones, where differences between the seasons are less marked, the patterns of annual emergence are more diffuse. Here, the dry season is short and erratic, and cicadas do not appear to synchronize hatches very well with it. Yet, I observed that a few species always emerge near the end of the dry season; and when dry conditions recur during the long rainy season, very low numbers of them appear.

The environmental stimuli that synchronize tropical cicada hatching with wetter or drier periods remain unknown. It is possible, however, that nymphs finished with their underground development phase respond to temperature and soil moisture changes. Whether they respond to season-related changes in the chemistry of food plant sap remains an intriguing question for future research.

It's easy to determine which species are active at various times of the year by noting their distinctive songs. Male cicadas of many genera produce a song characteristic for their particular species. The song is produced by a pair of special organs, called timbals, on the dorsal side of the first abdominal segment. Within these organs, riblike bands lying in a membrane are vibrated by powerful muscles, producing a whining or rasping sound that is amplified by large air sacs in the abdomen. The result, which may be audible at great distances, is believed to attract the female for mating.

Because successful reproduction in cicadas is often linked to the courtship song of the male, the song-producing mechanism has been subject to a great deal of natural selection. The song of an individual cicada may vary in different respects according to the time of day, and it is influenced by changes in temperature and in the amount of cloud cover. Cicadas that become adults, mate, and die during the rainy season will sing during cloudy weather and even in light rain, while dry-season species customarily sing only when the sun shines. The males of many species chorus in unison, usually at the edge of a forest or at a light-gap within the forest, as if to send out one big love signal. Thomas E. Moore, a noted University of Michigan cicada behaviorist, and other investigators have shown that a tape recording of a cicada's song played in a forest where the cicadas are silent can stimulate them to chorus in unison.

Observing that different species at each of my study sites had distinctive songs, I arranged for Moore to tape-record the songs of species at each site. We hope to use behavioral data from the tapes, together with the morphological and ecological data, to construct a key to the cicada species of Costa Rica, a tool that may prove useful to future researchers. Many of the genera and species discovered in my samples, and occurring in collections of other biologists in Costa Rica, also occur in other parts of Central and South America.

Cicadas have keen vision, and

Pacarina *cicadas on grass stems in an open pasture in Guanacaste Province, Costa Rica, during the rainy season. The genus* Pacarina *in Costa Rica and elsewhere in Central America is largely associated with semidry to dry pasture lands and shrub areas.*

Allen M. Young

A choral aggregation of males of Fidicina pronoe, *a dry season cicada, on branches of "madero negro," a legume tree, at the border of a black pepper field in Costa Rica.*

Allen M. Young

they use their large compound eyes in evading predators such as insectivorous birds as well as in recognizing members of their own species. In a few species of the genus *Zammara*, the males are splashed with vivid greens, while the females—in addition to being considerably smaller—are marked with a drab olive-green. Such sexual dimorphism, together with the loud rasp of the male, may enhance mate-recognition amidst the shaded foliage of the tropical forest. But I have frequently observed birds cue into a singing male *Zammara* and successfully pluck it from a tree trunk. Lizards may also locate male cicadas by orienting to their song. But the synchronous chorusing of hundreds of cicadas over large areas of the forest may confuse predators.

The "sun-down cicada," *Fidicina mannifera*, a large-bodied species, is so named because it choruses for only fifteen or twenty minutes near sundown and occasionally for a brief period at sunrise. This behavior is most evident in tropical rain forests, less so in dry forest areas, where adults of the same species can sometimes be heard at other hours.

It was the sun-down cicada that led me to one of the most interesting aspects of cicada ecology in Costa Rica. When I started my research on these insects, I often

Allen M. Young

Egg slits of Fidicina sericans *in a dead twig.*

Allen M. Young

Husks of two cicadas that often occur together in the same patches of tropical rain forest in Costa Rica: Fidicina sericans *below, and* Fidicina mannifera *above. The husks of different species are often easily distinguished in the field by color and other characters.*

found small clumps of the large, chocolate-brown glossy husks of this species beneath large legume trees, mostly *Pentaclethra*, in the lowland and foothill rain forest study sites.

Upon closer inspection over several years, I found that husks of several species continually turned up beneath legume trees, while much less frequently were they found beneath other kinds of trees in the same forest areas. This husk-legume association seemed to prevail in most of the sites I studied, including coffee plantations. In Costa Rica, legume trees of the genus *Inga* are used to shade the coffee bushes, and I found piles of husks beneath the legume trees and between the rows of coffee bushes, but very few husks were to be found away from these trees. The pattern of association was clear.

I also observed in rain forests that large-bodied species such as *Zammara smaragdina* and *Fidicina sericans* frequently place their eggs in dead branches and fronds of understory trees and palms just below the canopy of *Pentaclethra*. Thus, the cicadas seemed to be selectively placing their eggs very close to legumes.

Although none of the cicadas studied appears to be periodical, it might be that adults from a single batch of eggs will emerge in different years, with emergences occurring annually for several years following the minimum period for development. It might also be that cicadas tend to use the same patches of tropical forest repeatedly for breeding and that the target areas are those with large legume trees.

Why legumes? A very good question that still remains unanswered. If it is to be assumed that there is a general pattern of co-occurrence, and that the legume trees are isolated in pastures and yards, the question becomes one of determining the adaptive significance of the relationship. A key element is that legume trees are major components of climax forest formations in the tropics, but don't occur in temperate zone climax forests of the world. The relationship of cicadas with legume trees in the tropics may well be one of primordial origin arising in the early evolution of complex tropical forest communities millions of years ago.

Since legume trees do not occur in temperate climax forests, one would not expect such an association in temperate zones. There is no apparent relationship, in fact, between legume trees and cicadas in these regions. A search of thousands of black locust trees conducted along the shores of Lake Michigan yielded not a single cicada husk.

Because numerous cicada species require long development periods, natural selection might have favored the feeding association of the nymphs with those trees that provide the most, or best, nutrients. Doing so might accelerate the growth rate of cicadas and reduce the length of time required for development.

Enter the legumes. This plant family is noted for the association of many of its species with nitrogen-fixing bacteria that are in nodules on the roots. This is a symbiotic association in which the plant receives nutrients from the soil via the metabolic pathways of the bacteria, and the bacteria receive useful waste products from the tree's metabolism for their own use. An effect of the symbiosis is a more nutritious sap in legumes than in trees without such a relationship, and it is adaptive for cicadas to feed selectively on the former.

Other trees with different symbiotic associations with fungi and other plants, may also be candidates as hosts for the tropical cicada. I propose that the clumping of cicada husks beneath legume trees reflects a primary host association of the nymphs with the trees' root systems, though nymphs may also feed on roots of other trees in the area. All of this is speculation, but is nonetheless a worthwhile avenue of research, one aimed at determining the mechanisms responsible for the relationship between host trees and cicadas in the forests of tropical America.

When tropical forests are cleared away (and this destruction is occurring at an alarming rate) the availability of host trees for cicadas will shrink considerably, perhaps entirely. If the feeding association of nymphs with roots is a specialized one, cicadas in the tropics may not have the ability to switch to new, less nutritive hosts. □

OUR ENVIRONMENT

Arctic Peregrine Falcon Reclassified

The Arctic peregrine falcon, listed as an "endangered" species since 1970, has recovered sufficiently from the effects of environmental contaminants to be reclassified to "threatened" status, according to the Interior Department's U.S. Fish and Wildlife Service.

"Endangered" means that a species is in danger of extinction throughout all or a significant portion of its range. "Threatened," a less dire status, means that a species is likely to become endangered within the foreseeable future. A proposal to reclassify the Arctic peregrine to "threatened" status has been published in the *Federal Register.*

Data gathered by wildlife biologists indicate that the Arctic peregrine is not now endangered through a significant portion of its range. Levels of DDT and its metabolites have been decreasing in female peregrine falcons and the number of young falcons produced annually has increased since the mid-1970s. Strong protective regulations, vigorous law enforcement, and relatively secure habitat have also contributed to the Arctic peregrine's improved status.

The Arctic is one of three subspecies of peregrine falcons in North America. Arctic peregrines nest in Arctic regions from Alaska through Canada to Greenland and winter from the southern United States through all of Central and South America to central Chile and Argentina.

A second subspecies, the American peregrine, was extirpated as a nesting bird in the eastern United States during the 1960s and has been the subject of intensive recovery efforts, including release of captive-bred birds to the wild. The American peregrine remains classified as "endangered." A third subspecies, Peale's peregrine, is not considered "endangered" or "threatened."

Where Have All the Eagles Gone?

Results of midwinter bald eagle counts throughout the Midwest revealed only 508 eagles in 1983, compared to 933 in 1982 and 835 in 1981. This is a 46 percent decrease in total numbers despite more observers in the field, according to Eagle Valley Environmentalists, Inc., of Apple Valley, Illinois. This brings the wintering eagle population back to what it was about 15 years ago. The reason for this tremendous reduction is unknown. It follows a decline in bald eagle reproduction throughout the upper Midwest and central Canada during last summer.

Last year many people believed that bald eagles moved further south into states such as Arkansas, Mississippi, Texas and Oklahoma. If this were true then the recent mild winter should have allowed the eagles to stay in their more northern wintering areas. However, this does not appear to be the case, since no eagles were reported at Dams #2-6 on the Mississippi River and only a few were reported along the Wisconsin River.

The results of this winter's count demonstrates that in order to gain an understanding of bald eagle movements and population trends, there is a need for more intensive and more comprehensive studies of wintering eagles across the nation.

Florida's 'Weed Trees' Outlawed

Three types of tree in South Florida have been outlawed because they are harmful to human health or destroy other plants and wildlife.

All at one time were imported from abroad: the Australian pine; the melaleuca, a member of the myrtle family also of Australian origin; and the Brazilian pepper, sometimes called Florida holly.

State officials concede it may sound like something out of a horror film, but the menace is real.

"If everyone moved out, these three plants would take over," said Lisbeth Britt, a biologist called in to help enforce Dade County's new Exotic Tree Ordinance. "The melaleucas would take over the wetlands, the holly would take over the pinelands and the Australian pines, the beaches."

All three trees were introduced to Florida for what seemed like good ideas at the time. The Australian pine was used in the 1920s as a windbreak around citrus groves and because it grew so quickly. Melaleuca and Brazilian pepper became popular with landscapers.

Now, officials say, the Australian pine, which can grow 10 to 12 feet a year, is destroying the natural habitat of turtles and marsh rabbits on barrier islands. Shallow-rooted and brittle, it is also a threat to human life during strong winds.

The melaleuca, which blooms quickly enough to produce seed within three years of taking root, is a favorite nesting place for mice and rats. And it produces an oil that can cause asthmalike wheezing and coughing.

The Brazilian pepper sprouts huge quantities of red berries, which birds scatter all over the place. Large parts of the Florida Everglades are overgrown, threatening the swampy area's unique natural fauna.

Jack Ewel, a botanist at the University of Florida, says the imported trees, thriving in part because of environmental disruption, "could result in plant and animal communities in south Florida that the world hasn't seen before."

That is not a happy thought for county officials, who already have to deal with toads, which can poison dogs and cats, and alligators, which occasionally turn up in canals and swimming pools.

Under the ordinance, the "weed trees" may no longer be imported, grown, planted or transported in Dade County.

Communities have begun programs under which residents can request free removal and replacement of Australian pines and melaleuca hedges.

An Australian pine eradication program is under way at Cape Florida State Park on Key Biscayne, an island just south of Miami Beach. The trees are slashed and a herbicide is injected, killing them within six to eight months.

Brazilian pepper and melaleuca are not so easy to destroy. Direct use of herbicide on melaleucas will cause the seed pods to burst and scatter. Brazilian pepper stumps and roots put out new suckers almost as soon as the trunks have been sawed off.

Floridians have only themselves to blame, Mr. Ewel says. Not only were the "exotics" imported by people, but disruption of the natural environment by developers and farmers has also helped them spread so rapidly, he says.

A team of University of Florida biologists found, for example, that it was almost impossible to establish the Brazilian pepper in an undisturbed forest.

Ewel says that since southern Florida is so young, geologically speaking, it is not fully populated by naturally spreading plants and animals, and imported ones become naturalized as they find "niches" in the ecosystem.

Plants of the World Photography Competition 1983

The exhibit "Plants of the World" will open at Field Museum on September 24. In celebration of flowers and the exhibit opening, the Museum announces the Plants of the World Photography Competition, cosponsored by Field Museum, Standard Photo, Helix Ltd., and Astra Photo Service. All members who are photographers (regardless of residence) as well as non-member photographers in the Chicago metropolitan area may submit slides of flowers and plants without any further restrictions on subject matter—any subject in the realm of the plant kingdom is acceptable. The competition is divided into two age groups: Group I entrants must be under 17 years old as of August 1, 1983; Group II entrants must be 17 years or older as of August 1, 1983. To enter, complete the form below. Slides must not be mounted in glass. Only original slides that have not been published are acceptable. Indicate the proper slide orientation for projection with a dot in the upper right corner of the mounting on the non-emulsion side, together with your name and slide title. Please make your check payable to Field Museum.

Winning photographs will be featured in the October *Bulletin* and in Gallery Nine, September 23 through October 11. An individual membership to Field Museum accompanies the award. The Museum reserves the right to publish, exhibit, and use for promotion the winning photographs. The decision of the judges is final.

Six Honorable Mentions will be on exhibit and receive memberships. Winners of Certificates of Selection will also be on exhibit.

Judges: Dr. William Burger, Chairman, Department of Botany, Field Museum; John Alderson, award-winning commercial photographer, columnist and critic, Chicago *Sun-Times*; and Ron Bailey, award winning photographer, Chicago *Tribune*.

Eligibility

Competition is open to photographers in the Chicago metropolitan area (Cook, Lake, McHenry, Kane, DuPage, and Will counties) and *all* museum members. Employees of Field Museum and the cosponsor and their immediate families are not eligible.

Entries

A completed entry form and entry fee of $5.00 must accompany each entry of one to three 35mm color slides. Entrants may submit three entries of 1 to 3 slides each (a maximum of 9 slides for the contest).

Entry forms are also available at Field Museum's information Desk. The form may be photocopied for additional entries.

Delivery

Entries will be accepted between August 1 and 15. Mail to:

Field Museum Photography Competition
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605

Pack entries *with care*. Field Museum assumes no responsibility for damage or loss in shipment, delivery, and/or return.

Returns

Enclose a self-addressed, stamped envelope for return of entries. Entries not so accompanied will be discarded. Field Museum assumes no responsibility for damage or loss in return mail.

Awards

- **Grand prize:** Minolta XD11 camera with 50mm 1.7 lens; photo will also appear as cover illustration for October 1983 Field Museum *Bulletin*
- **First prize:** (Group I) Helion all-weather rubber-coated 8x10 binoculars; (Group II) weekend trip to Horicon Marsh to view Canadian goose migration.
- **Second prize:** (Group I) $50 worth of film processing; (Group II) $100 worth of film processing.
- **Third prize:** (Group I) Helix 101 flash unit; (Group II) Kamrac camera bag.
- Certificates of selection.

Entry Form: Plants of the World Photography Competition

This form must accompany all entries. Use the guidelines above as a checklist.

Name_____ Daytime phone_____

Address_____
street

_____
City State Zip Code

Group I____ Group II____

Enclose $5.00 check or money order payable to Field Museum of Natural History.

I understand and agree to the conditions of the contest as stated in the above guidelines.

Signature: _____ Date: _____

FIELD MUSEUM OF NATURAL HISTORY BULLETIN

July/August 1983

Biennial Report 1981-1982

Field Museum of Natural History Bulletin

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COVER

Sites of field work by Field Museum scientists around the world in 1981-82, the period covered by this biennial report. Each blue dot identifies the location of field work by one of the Museum's anthropologists, botanists, geologists, or zoologists. For more on these activities see the Collections and Research sections of this report.

The nine sculptures shown in this report are the work of Henry Hering (1874-1949), and were commissioned for the Field Museum building and completed, for the most part, in 1918. Those shown on pages 20, 21, 23, and 25 are relief sculptures on the building's exterior, and represent the Museum's four curatorial departments. The sculpture on page 28 is one of four identical pieces—so-called caryatids—that serve as roof-supporting columns on the four small porches flanking the north and south entrances. They are paired with an equal number of nearly identical statues. The two types differ mainly in stance. The statues on pages 30, 32, 34, and 36, representing "Nature," "Record," "The Dissemination of Knowledge," and "Research," are in the four corners of Stanley Field Hall. The exterior pieces are of Georgian white marble, the inside ones of plaster. All are done at the same scale—about twice life-size. Hering also did the medallion with lion's head center that is repeated several times inside the building and out, as well as gargoyle-like lion's heads, in terra cotta, also to be seen at several points along the eaves.

Events

Special Events

Summer Evening with Star Gods
A joint program with the Adler Planetarium
Saturday, July 30 or Sunday, July 31
4:45pm, James Simpson Theatre, West Entrance

Native North Americans were as fascinated with the night skies as we are today. From their fascination with the heavens and beliefs about the universe grew a cosmology that colored and shaped their lives. Bring the family and join us as we enter the world of the Star Gods.

The evening begins in James Simpson Theatre with a brief orientation to the cultures of selected North American Indians including the Pawnee, the Hopi, and tribes of the Northwest. Then take an after-hours trip to the Museum's North American Indian halls, the Pawnee Earth Lodge, and related Indian exhibits. Examples of the traditions, astronomical legends, and cultures of these early Americans are highlighted as you browse through the exhibits.

At 5:45pm, wander down the mall to the Planetarium and enjoy a picnic supper on the plaza. Families are invited to bring their own picnics or reserve a chicken box supper.

After the picnic, we enter the Planetarium Sky Theatre and Phyllis Pitluga, senior astronomer, takes us on a special trip to the skies of the Star Gods as they were seen from the prairies of the Pawnee Indians to the shores of the Northwest Coast centuries ago. Following this special show, everyone is invited to visit the "Star Gods of the Ancient Americas." The Planetarium hosts this traveling exhibit from the Museum of the American Indian, New York City, through September 12. The show presents the ancient astronomical lore of five native American cultures with more than 150 spectacular archaeological artifacts.

Members: $3.00
Nonmembers: $5.00
Box Suppers: $4.00

Section A: Saturday, July 30
Section B: Sunday, July 31

Please use the coupon below to order tickets; be certain to include section (A or B) requested. If you are ordering chicken box suppers, include the number requested and payment.

Registration

Please complete coupon for *Summer Evening with Star Gods*. Complete all requested information on the application and include section number where appropriate. If your request is received less than one week before program, tickets will be held in your name at West Entrance box office until one-half hour before event. Please make checks payable to Field Museum. Tickets will be mailed on receipt of check. Refunds will be made only if program is sold out.

Program Title	Section	Member Tickets # Requested	Nonmember Tickets # Requested	Total Tickets # Requested	Box Supper # Requested	Amount Enclosed
Summer Evening with Star Gods						

Name _____

Street _____

City _____ State _____ Zip _____

Telephone _____ Daytime _____ Evening _____

Have you enclosed your self-addressed stamped envelope?

For Office Use:

Date Received _____ **Date Returned** _____

Return complete ticket application with a self-addresed stamped envelope to:

Public Programs: Department of Education
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605-2497

Highlights

Family Feature, July
"The Simple Cell, Not So Simple"
Saturday and Sunday, July 9 and July 10
1:30pm, Lecture Hall I, West Entrance

The cell is the basic unit of all living things. Some cells are separate microscopic organisms which can perform all the activities necessary for their own survival. Although these organisms are single cells, they are not "simple." They have been evolving for millions of years and each species has adapted to its tiny corner of the environment. Use microscopes to explore a hidden world and find out about the lives of these fascinating organisms which thrive in the air, in water, and even in yourself.

"Arctic Antics"
Saturday, August 6, 1:00pm
Hall N—North (Marine Mammals Exhibit)
Ground Floor

Dress as your favorite polar pal (penguins are easy) and come to see Field Museum's films concerning life in and out of the Arctic waters. Listen to the sounds of a humpback whale in our underwater environment and take a close look at the social lives, habitats and communication systems of penguins, sea otters, whales, and sea lions.

1:00pm, "Six Penguins" (5m) In this delightful puppet animation, six friendly penguins help rescue a whale that is stuck in ice shards. Later, the whale returns the favor and rescues the penguins from a polar bear.

1:10pm, "Otters: Clowns of the Sea" (14m) An otter pup is lost and dramatically reunited with its mother in a film that documents this creature's unique abilities, including food gathering and using tools.

1:25pm, "Beluga Baby" (25m) Watch the drama of the struggle for life of a baby beluga whale, born in captivity at the Vancouver Aquarium in British Columbia.

2:00pm, "The Sea Lions" (9m) Take a look at the lives of sea lions: sunbathing, swimming, and nuzzling pups.

Family Feature, August
"Hopi Sand Painting"
Saturday and Sunday, August 27, 28
1:00pm, Hall 7, Indians of SW United States

The farming people of the deserts of the American Southwest depend upon rain for their crops to grow. Sand paintings are made on the ground to influence powerful spirits to bring rain, plentiful crops, and other beneficial things to man. Sand of many colors, corn pollen, and crushed flower petals are used to "paint" symbols of the sun, stars, clouds, snakes, or spirits. Learn about the lives and ceremonies of the Hopi and design your own colorful sand painting.

Weekend Programs

Each Saturday and Sunday you are invited to explore the world of natural history at Field Museum. Free discovery tours, demonstrations, and films related to ongoing exhibits at the Museum are designed for families and adults. Check the Weekend Passport upon arrival for the complete schedule and program locations. These programs are partially supported by a grant from the Illinois Arts Council.

July

23	1:30pm	*Tibet Today*, slide lecture/tour
24	12:30pm	*Museum Safari*, tour

August

6	11:00am	*Ancient Egypt*, tour
14	12:30pm	*Museum Safari*, tour
20	1:30pm	*Eskimos: Hunters of the North*, tour
21	1:30pm	*Treasures from the Totem Forest*, tour
28	12:30pm	*Museum Safari*, tour
	1:00pm	*Life in Ancient Egypt*, tour

Photography Competition

Plants of the World
Photography Competition 1983

The splendid exhibit "Plants of the World" opens at Field Museum on Saturday, September 24. Over 400 plant models, 5 magnificent dioramas, and thirteen large murals are included in this exhibit.

In celebration of this exhibit opening, the Museum announces the Plants of the World Photography Competition. Photographers who are Field Museum members or who live in the Chicago metropolitan area are encouraged to submit 35mm slides of any subject in the realm of the plant kingdom. Entries will be accepted between August 1 and August 15, 1983.

For further information and entry form, see page 43.

Field Museum of Natural History Biennial Report 1981-82

Dedicated to
E. Leland Webber

Ron Testa

After thirty years of extraordinary leadership, Lee Webber became president emeritus of Field Museum on August 31, 1981. For two decades, he served as director and president, providing basic direction and strength in all areas of Field Museum operations. During those years he developed a strong financial base for the Museum, significantly improved the physical plant, and stimulated important programmatic development. His leadership secured for Field Museum a continuing place among the foremost natural history institutions of the world.

Lee Webber is a museum leader in Chicago and in the United States. As the dean of Chicago museum executives, his counsel is sought by his city colleagues. As a national leader, he serves as chairman of the Legislative Committee of the Association of American Museums, and has been a member of the National Council for the Arts and the Institute of Museum Services. He earlier chaired the commission which formulated the Belmont Report, the landmark statement on American museums.

In addition to his museum leadership, Lee Webber is a dedicated volunteer and advocate on behalf of all nonprofit organizations. He continues his commitment to Field Museum as special adviser to the president and is actively involved in a variety of Chicago civic concerns.

In every way Lee Webber sets the example for the future of Field Museum. We esteem him as the modern builder of this great institution.

Ron Testa

Louise Belmont

Unlike most contemporary museums, Field Museum of Natural History remains true to the original Platonic idea of a museum as a place of speculation and research in conjunction with collections. Natural history collections contain the direct evidence of being. Field Museum deals with the relationship of life and things on this planet, cataloguing and explaining the enduring and fundamental nature of our living together.

Field Museum collects, studies, exhibits, and teaches. It combines the sciences, humanities, and arts through anthropology, botany, geology, and zoology. In its mission, Field Museum ranges from a children's museum to an advanced institute of international importance.

The Museum's concerns are worldwide in terms of natural phenomena and human history. Scholars and visitors come from around the globe to learn. At any one time, some 100,000 items from the collections are on loan for study and exhibit. The Museum's curators are engaged in research on every continent, as the cover of this report depicts. The people of Chicago and Illinois are the special beneficiaries of this center of learning.

The 1981-82 biennium was a time of significant advancement for the Museum. We are deeply indebted to the many individuals, businesses, foundations and governmental agencies which made these programs possible through their generous contribution of time and funds. We are pleased to present this report of our most recent biennium, documenting in brief collections, research, teaching, exhibition, publications, and other significant achievements of the people who made Field Museum strong during that period.

People, not structures, make a great museum. Field Museum is staff, trustees, volunteers, members, donors, visitors, and taxpayers. All have made the 1981-82 Biennium a time of accomplishment for the Museum.

Nearly 400 staff members devote themselves to conducting the day-to-day activities of this diverse institution. In addition to the thirty-five members of the curatorial staff, there were nearly 100 staff members engaged in various aspects of research and collection management. The Department of Education staff of twenty-four provides educational programs and public events which benefit thousands. The Exhibition Department provides the aesthetic and design dimension enjoyed by all visitors.

Physically the largest museum in Chicago, nearly a million square feet were well cared for and provisioned by the

Top to bottom: Edward Olsen, curator of mineralogy, Department of Geology, explores ice cave, Devon Island; Carolyn Moore, Volunteer, Department of Anthropology, with Japanese lacquerware on view in Hall 32; Timothy Plowman, assistant curator, Department of Botany (right, with Tony Swain, Boston University), collecting specimens in Upper Amazon region; Division of Mammals preparators Jean Sellar and Michael Reed (left and center), with Assistant Curator Bruce D. Patterson, hold tusk of Ziggy, the Brookfield Zoo elephant who died in 1975. The elephant's skeleton was added to the collection.

responsible staff. Visitors Services and Security staff were cordial hosts to visitors as well as round-the-clock guardians of the Museum's treasures. The Engineering staff conserved energy and met the varying needs of the seasons, night and day. Maintenance kept the building sound and attractive. And Housekeeping provided a bright, inviting environment in which our visitors could participate and enjoy the vast storehouse of knowledge that is Field Museum.

Visitors and connoisseurs alike were intrigued by the Museum's store. People enjoyed lunches and dinners in our dining facilities. We were also the venue for many of Chicago's great social and civic affairs.

Our Membership and Public Relations departments along with the *Bulletin,* Fieldiana, Mailing and Printing Services kept us in close touch with our many constituencies. The Tours program offered exciting journeys. The Development staff enlisted the financial support of corporations and individuals; while the Financial Department saw to it that our bills were paid and our budget balanced.

The work of the Museum was also carried on by enthusiastic and able volunteers; the gift of time is as vital to the mission of the Museum as the gift of funds. The Women's Board has provided both. Happily, our corporate and individual donors of funds increased in number and in size of their contributions. Chicago, Illinois and American taxpayers demonstrated their steadfast commitment to the Museum through their governmental grants.

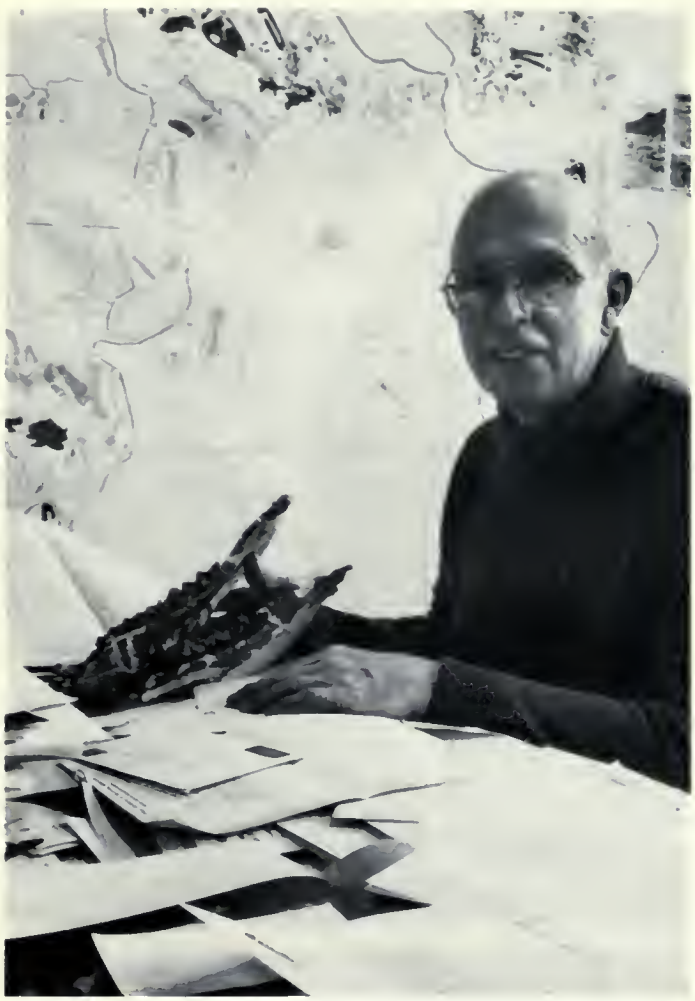
The governance of Field Museum rests with the Board of Trustees. During the Biennium, 33 individuals served as trustees and life trustees. William G. Swartchild, Jr. served with distinction as Chairman of the Board. He provided imaginative and dedicated leadership. In addition, he was recognized as a national leader among museum trustees. In January, 1982, James J. O'Connor, Chairman of the Board of Commonwealth Edison Company, was elected chairman. He is demonstrating his vision and commitment to the future of this museum through his outstanding leadership as chairman.

Two distinguished life trustees of Field Museum died during 1982. William McCormick Blair served as trustee from 1939 to 1972 and Paul W. Goodrich from 1966 to 1980. Each in his own way made enduring and vital contributions to the advancement of the Field Museum. We are ever indebted to them both.

On September 1, 1981, Willard L. Boyd succeeded E. Leland Webber as president of Field Museum. Boyd came from the University of Iowa, where he served as president and professor of law. He also served as a member of the National Council on the Arts, chairman of the American Association of Universities, chairman of the Section on Legal Education of the American Bar Association, chairman of the Center for Research Libraries, and as a member of the Advisory Board of the Metropolitan Opera.

Those who joined the scientific staff during the biennium included Bruce D. Patterson, appointed assistant curator of mammals in 1981; Peter Crane, named assistant

James J. O'Connor (above) and William G. Swartchild, Jr.


Ron Testa

William Turnbull, curator of fossil mammals, with titanothere jawbone from Washakie Basin (Wyoming). Turnbull has found there about 20 relatively complete skulls of this ancient relative of the horse, which roamed that region 42-46 million years ago.

curator of paleobotany in 1982; and James S. Ashe, appointed assistant curator of insects in 1982.

Donald Skinner, who had been acting department head, was named chairman of the Department of Exhibition in 1981; and Glen H. Cole, curator of Old World prehistory, was appointed chairman of the Department of Anthropology in 1982, succeeding Phillip H. Lewis in that post. Andrea G. Bonnette was named to the new post of vice president, Finance and Museum Services, as part of a reorganization of the Museum's administrative structure. Joann Thorson was appointed to the new post of manager of Financial Operations and Patricia Parks joined the staff as administrator of Human Resources (as the Personnel Department was redesignated).

Retiring staff members included Eugene S. Richardson, curator of invertebrate fossils, who left in 1982 and died on January 21, 1983; and Hubert A. Homan, manager of Personnel, who left in 1981 and died on March 25, 1983. Curator Emeritus of Insects Henry Dybas died on October 5, 1981; he had served on the staff from 1941 to 1980. Former chief curator of zoology Austin L. Rand died on November 6, 1982. Rand had been a Field Museum staff member from 1947 to 1970.

Our visitors have enlivened our days and Biennium. We are grateful to the thousands of people who have made 1981-82 such an exciting Biennium for Field Museum.

We are our institutions, their successes are our successes.

Museum collections of anthropological, biological, and geological specimens are banks for storage and retrieval of basic information. They are the tangible and permanent sample and record of the earth, its biota and, in the case of human culture, the documentation and record of man and society. They provide an indispensable source of information for an ever-increasing number of scientific and educational, governmental users. Field Museum's collections and libraries are the primary basis for research efforts of the staff, associates, and a very large professional and lay constituency. The collections are also the nucleus and primary source of excellence in the Museum's exhibition programs, and they serve a diversity of educational needs, including the varied programs of the Department of Education. The assembling and maintenance of collections are basic reasons for the very existence of the natural history museum.

The Museum's collections increased by some 516,000 specimens during the 1981-82 biennium. The Anthropology collection grew in size to a total of 410,500 specimens with the acquisition of 2,650 items. These were included in 80 accessions through gifts, purchases, and exchanges. The Geology collection grew by the addition of 48,000 specimens, mostly collected by members of the department. Important additions also occurred as gifts from 100 individual and corporate donors. A total of 48,272 specimens were accessioned by the Department of Botany during the biennium. Most were from the neotropics (New World tropics), the area of the department's particular strength.

The collections of the six divisions of the Department of Zoology grew by a total of 417,245 specimens in 1981 and 1982 (Insects: 266,315; Invertebrates: 54,164; Fishes: 87,922; Birds: 4,390; Amphibians and Reptiles: 3,153; Mammals: 1,301). Collection additions follow clearly stated departmental accession priorities, which are designed to strengthen existing collections.

Today most basic research is done in university or governmentally supported laboratories. Field Museum is the exceptional independent research institution. Its research is significant in the biological and earth sciences and in anthropology.

ANTHROPOLOGY. The principal research of Bennet Bronson during 1981-82 concerned preindustrial iron metallurgy of Asian cultures (a collaborative study with Prof. William Rostoker of the University of Illinois at Chicago).

Glen Cole continued working on a report concerning the Chaminade School Prehistoric Site, in Malawe. He completed study of the artifacts recovered from the excavations and continued a statistical analysis. In another continuing project, Cole gathered data and analyzed artifacts from the Isimila Prehistoric Site in Tanzania. He also resumed work on sediment analysis of material from the Nsongezi Prehistoric Site in Uganda.

Alan Kolata's fieldwork and writing focused on two very different regions of the Andes: the Bolivian highland plateau and Peru's desert coast. He also made surveys of archaeological sites related to the Pre-Columbian empire of Tiwanaku around Lake Titicaca in Bolivia.

Phillip Lewis did field work in Lossu Village, northern New Ireland, from May through August, 1981, revisiting an area he had studied in 1953-54 and in 1970. The 1981 work, funded by an NEA Fellowship for Museum Professionals, involved observations of *malanggan* memorial ceremonies and updating the village census and map—data that will provide a historical view of the village settlement pattern back to 1929.

The research of Michael Moseley and Robert Feldman focused on analysis of agrarian collapse in Peru. Two physical processes, they report, are implicated in Andean agrarian collapse. The basic contributory process is gradual uplift of the Pacific watershed related to high rates of tectonic activity along the Andean continental margin. The continental margin is being underthrust by the sea floor at rates of 10 centimeters (2.54 inches) per year or more, causing ground slope changes. The second process involves rare, but recurrent torrential rains, which are caused by El Niño perturbations of normal and meteorological currents. When major rain falls do occur—as in 1925 and 1982—they fall upon steep, unvegetated land surfaces that have experienced tectonic destabilization. As a result, drainage systems flood, producing extensive and intensive erosion and mass wasting.

Phyllis Rabineau began a research project on the costumes used during contemporary American Indian dances,

Glen Cole, curator of Old World prehistory, with "Middle Stone Age" artifacts from Nsongezi (East Africa).

Christine Niezgoda, assistant in Department of Botany, with scanning electron microscope. The SEM is used extensively by all scientific departments.

conducting research at the Huntington Library, Pasadena, California, where she located notes and photographs of Grace Nicholson. Most of Field Museum's northern Californian ethnographic materials were collected by Nicholson, who was probably the source for most of the Museum's Homer Sargent basket collection.

John Terrell, in February 1981, took a six-month leave of absence to be Visiting Senior Fulbright Lecturer and Research Scholar at the University of Auckland in New Zealand. While there he taught a course on Pacific prehistory. He also continued to research and write a book concerning *Science and Prehistory in the Pacific Islands* (the proposed title). Terrell took another leave of absence, beginning in August 1982, to serve as Visiting Professor of Human Ecology at the State University of New York in Binghamton.

James W. VanStone completed research on the Museum's collection of Northern Athapaskan clothing and on the collection of Montagnais material culture made by Frank G. Speck. He completed research on the collection of Plains Cree material culture made by the late S.C. Simms, and did research on Southern Tutchone clothing and territorial groups in west-central Alaska before 1898. VanStone also initiated research on the William Duncan Strong collection of Naskapi material culture.

In 1982, shortly after the completion of the Maritime Peoples of the Arctic and Northwest Coast exhibit (Hall 10), Ronald Weber was named an Anthropology research associate. He researched the Lt. George Emmons collection of Tlingit basketry. This research also involved editing Emmons' notes on the collection for possible publication. Weber was involved in Amazonian prehistory research as well.

Before leaving the Museum in 1981, Donald Whitcomb traveled to Egypt to conduct fieldwork. He also prepared for publication a preliminary excavation report on Quseir al-Qadim and a final excavation report of Qasr-i Abu Nasr.

BOTANY. The primary objective of botanical research at Field Museum is classification and nomenclature. This means getting related specimens together in realistic categories (e.g., genera, species), then determining that they have the right names. This work is generally done in two ways: by working with a specific group of plants to produce monographs and revisions, and by working in a specific region to produce a flora; both are done at Field Museum. The geographic areas of concentration are Veracruz (Mexico), Costa Rica, and Peru. Groups studied intensively include the coca family, several groups in the sunflower family, the puffball (fungi) family, and Southern Hemisphere liverworts.

Of the permanent staff, William Burger studied the flora of Costa Rica and flowering plant evolution, Michael Dillon studied the Compositae family and the flora of Peru, John Engel studied liverworts of the Southern Hemisphere, notably Tasmanian liverworts, Timothy Plowman studied the Coca family and worked on ethnobotany of the Upper Amazon Basin, Patricio Ponce de Leon worked on the puffball

family and mushroom identification. Four visiting curators were also actively engaged in research: Kerry Barringer (flora of Costa Rica), Sylvia Feuer-Forster (pollen studies), Michael Huft (flora Mesoamericana) and Michael Nee (flora of Veracruz).

Important useful plants have, in many cases, had long histories and have often been grown and prepared in a variety of ways. The leaf of the Coca tree fits this pattern, and there is archaeological evidence that it has been used for thousands of years. Chewing coca leaves has made it possible for people to work effectively at very high altitudes in the Andes mountains. Timothy Plowman continued to study the ethnobotany of coca with chemists, archaeologists, anthropologists, and medical researchers, in unraveling the many aspects of this fascinating plant.

In studying the medicinal plants of the Upper Amazon forests, Plowman points out that the native Amazonians are remarkably astute; they soon realize that modern "western" medicines are very effective. Unfortunately, they are coming to eschew their native medicines as they shift to modern pharmaceuticals. While this is reasonable to them, it is disturbing to us, for they are abandoning plant-derived medicinals, some of which have never been investigated by science. There is a strong likelihood, Plowman emphasizes, that we may thus lose important knowledge that might otherwise lead to effective new medicines for all of us. Salvaging this rapidly disappearing knowledge should have high priority, but the active cooperation of botanists, anthropologists, and chemists is required.

Jin Yu-gan, of the Nanjing Institute of Geology and Paleontology, studied Mississippian brachiopods at Field Museum under the Department of Geology's Visiting Scientist Program in 1981.

GEOLOGY. Research topics pursued by Geology staff in 1981-82 included: Origin of frogs (by John Bolt); evolution of the ear and hearing in amphibians (Bolt); computer simulation of tooth replacement in reptiles and amphibians (Bolt); paleobotany and evolution of the birch family in the northern hemisphere (Peter Crane); structure and function of reproductive organs in early flowering plants from several localities in the U.S. (Crane); morphology, evolution, and relationships of fossil algae from the Paleozoic era (Matthew Nitecki); search for an iridium anomaly, which would be indicative of a meteorite impact, associated with a major extinction event 350 million years ago (Edward Olsen); evolution of the solar system as inferred from study of a new kind of carbonaceous meteorite (Olsen); computer simulation of growth in a group of fossil invertebrates (David Raup); quantitative analysis of evolutionary patterns throughout the fossil record (Raup); evolution of the mammalian fauna in a great intermontane basin in Wyoming 45 million years ago (William Turnbull); anatomy of the ear region in an early mammal from China (Turnbull); changes in the composition and orientation of mineral grains during deformation (Bertram Woodland).

A ten-day field trip by Peter Crane to the Potomac Group of the Atlantic coastal plain produced sediment samples with well preserved plant material for detailed examination in the laboratory. This yielded a diverse and interesting sub-macro-fossil flora of conifers, ferns, gingkophytes,

Robert Timm, assistant curator and head, Division of Mammals, measures warthog teeth.

cycadophytes, and angiosperms. The angiosperm remains in the samples are currently some of the oldest of all flowering plants known.

In the fall of 1981 Matthew Nitecki was a guest scientist of the USSR Academy of Sciences. Most of his time was spent at the Institute of Geology and Geophysics in Academgorodok in Novosibirsk, where he worked with Soviet paleontologists on problematic Lower Paleozoic fossils. He also studied Paleozoic algae at the Paleontological Institutes in Leningrad and Moscow.

In the summer of 1981 Olsen was part of a four-man expedition to the Canadian arctic islands to search for meteorites on two ice caps. Because meteorites are very well preserved in cold conditions, the ice cap in Antarctica has yielded thousands of fragments of them. The ice caps on Greenland and in the Canadian arctic will probably also be sources of these objects. However, heavy melting conditions (which permits meteorites to sink into the ice) were encountered, and no meteorites were found.

William Turnbull spent two seven-week seasons in the Washakie Basin (Wyoming) in relation to the systematic study of the mammalian fauna.

Bertram Woodland did fieldwork to support the research involved collecting in the Upper Peninsula of Michigan and in North Wales and the Southern Uplands of Scotland. The research of these staff members was supported by the following field work and research trips:

John Bolt spent three weeks in 1981 in the Lower Permian (275 million years ago) of Oklahoma and the Upper Triassic (200 million years ago) of Texas and three weeks in the Upper Triassic of Arizona. In 1982, he spent a month in the Upper Triassic of Arizona (Petrified Forest National Park). (His interest in the Triassic stems from his conclusion that ancestors of the modern amphibian orders are likely to be found in the Triassic—so far the earliest modern amphibians, with a single possible exception, are from the Jurassic.) The Petrified Forest yielded a rich quarry, but the presence of modern-type amphibians is, of course, not certain.

Twelve researchers participated in the Visiting Scientist program in the Department of Geology during the biennium, six each in 1981 and 1982. K.S.W. Campbell, Department of Geology, The Australian National University, Canberra, studied Paleozoic lungfishes (of which Field Museum has a good collection), and Silurian and Devonian trilobites. George McGhee, Department of Geological Sciences, Rutgers University, worked on mathematical description and simulation of shell growth and on the paleocology and evolution of Late Devonian marine communities. Glenn Merrill, Department of Geology, The College of Charleston, Charleston, South Carolina, worked on depositional history of black shales of the Illinois Basin. Colin Patterson, Department of Paleontology, British Museum (Natural History), worked on a handbook of Paleoichthyology and other projects. Siegfried Rietschel, director, Landessamlungen für Natürkunde Karlsrühe, Karlsrühe, West Germany, worked on receptaculitids (fossil algae) with Matthew Nitecki. W.D.I. Rolfe, Hunterian Museum, Glasgow, Scotland, studied Paleozoic arthropods, especially from the Mazon Creek faunas. Jin Yu-Gan, Nanjing Institute of Geology and Paleontology, Academia Sinica, studied Mississippian brachiopods. Antoni Hoffman, Institut für Geologie und Paläontologie, Tübingen, West Germany, worked on evolution of marine ecosystems.

ZOOLOGY. Members of the scientific staff of the Museum's largest department, Zoology, were also involved in diverse research activities. Alan Solem, of the Division of Invertebrates, worked principally on species diversity of New Zealand land snails and on the morphology of certain Australian land snails.

In the Division of Insects, John Kethley worked on techniques for recovering mites from bird skins in the Museum collection and on a revision of the classification of certain mite groups. Larry Watrous reviewed classification of certain genera in the beetle family Tenebrionidae. In the Division of Fishes, Donald Stewart worked on the systematics and ecology of fishes of the Upper Amazon Basin and on revision of the catfish genus *Cheirocerus*. Robert K. Johnson worked on the systematics, morphology, interrelationships, and larval development, notably in fishes of the Gulf of Honduras.

In the Division of Birds, John Fitzpatrick completed a study of the Florida scrub jay. Fitzpatrick and David Willard studied population densities and distribution of Eastern Great Lakes birds. Ongoing projects included studies of flycatcher morphology and ecological studies of certain Peruvian birds. In the Division of Amphibians and Reptiles, Robert F. Inger worked on variation in flying lizards and on the morphology of certain frogs. Harold Voris studied the

diet of sea snakes and Hymen Marx investigated morphological variation in skeletal structure of snakes of the supra-family Colubroidea. In the Division of Mammals, Bruce D. Patterson, who joined the staff in July, 1981, worked principally on aspects of evolution and adapation in chipmunks of Southwestern United States. Robert Timm studied species variation and hybridization in pocket gophers.

Fieldiana, Field Museum's continuing series of scientific monographs, published 25 titles during the biennium, including four in Anthropology, six in Botany, Eight in Geology, and seven in Zoology. Especially noteworthy in the 1981-82 list was the long-awaited, 746-page *Catalogue of Chinese Rubbings from the Field Museum,* which represented the culmination of some 20 years of curatorial research and 15 years of editorial work. John R. Bolt, chairman of the Department of Geology, is scientific editor of Fieldiana; Tanisse R. Bushman is managing editor.

Catalogue of Chinese Rubbings from the Field Museum, *in the Fieldiana Anthropology series.*

As the Department of Education launched into the 1980s, the staff reviewed past successes and looked to future opportunities for new programs and audiences. Thus, 1981-82 was approached with a keener awareness of visitors and their needs.

Program emphasis is focused on teacher training, school programs, and loan materials developed in concert with school curricula, and participatory programs for adults, families and children. The Museum's rich and diverse collections on exhibit together with the Museum's curatorial expertise form the base for a broad variety of offerings. The sixth annual Anthropology Film Festival brought world cultures and traditions to our attention, "Dinosaur Day" was born, and festivals involved many people from Chicago's major ethnic communities.

The major programmatic effort was devoted to the celebration and opening of Maritime Peoples of the Arctic and Northwest Coast exhibit. High points included the traditional raising of the totem pole "Big Beaver" in front of the Museum, lectures by authorities on Eskimo and Northwest Coast cultures, and performances that made history—particularly by members of the Hunt family, whose Kwakiutl ancestors had performed here in 1983.

The major goal of the Department of Education is to increase programs and participation, while maintaining the high quality for which we are noted. The following statistics provide an overview on participation in 1981-82: 6,464 school programs for 209,671 students and teachers; 5,603 free loans delivered to schools, 5,502 items picked up at the Museum by teachers; 198 courses for 5,782 adults; 119 field trips for 4,157 adults and families; and 918 Weekend Discovery Programs for 28,671 visitors. The sum total of these and many other special programs including children's workshops is 8,048 programs attended by 696,426 people, or 40 percent of all Museum visitors.

This service could not have been provided without the assistance of dedicated and knowledgeable volunteers.

Public raising of 55-foot totem pole in front of Field Museum on April 24, 1982.

Department of Education class seines for specimens in local creek.

Over 350 volunteers served Field Museum on a one- to three-day weekly basis. Of these, 150 assisted as instructors in the Department of Education. The Pawnee Earth Lodge and Place for Wonder, for example, could not have opened to the public every day without them. During 1981-82 volunteers contributed 89,312 hours or the full-time equivalent of 25 staff members. These figures help to demonstrate that the department's role of interpreting the collections to the public is being felt by a rapidly widening segment of the community.

Two new programs were initiated in 1982, a two-year student-teacher training program, funded by the Joyce Foundation; and funds for a three-year national, regional, and local professional midcareer training program were awarded by the W.K. Kellogg Foundation.

The Department of Education also received funding for special programs during 1981-82 from the following sources: Illinois Arts Council, National Endowment for the Arts, National Endowment for the Humanities, the Field Museum Women's Board, the Spensley Fund, the Mayos, University of Illinois at Chicago, and the Chicago Board of Education.

The April 24, 1982, opening of "Maritime Peoples of the Arctic and Northwest Coast" was the most significant and memorable exhibition event of the biennium. Subject matter leadership was provided by James VanStone, curator of North American archaeology and ethnology, and by Ronald L. Weber, visiting assistant curator. The exhibit contrasts the cultures of the Northwest Coast with that of the Eskimo cultures.

A sequence of five galleries provide an introduction to the exhibit and, successively, treat fishing, hunting, and gathering; village and society; the spiritual world; and art. Each hall offers three levels of presentation to accommodate different visitor interests and needs. Visitor-activated audio-visual units and an innovative exhibit case illumination system enhance the presentation of nearly 2,500 objects from the Museum's collection.

The opening was accompanied by a variety of ceremonies and programs, most notably the raising of a 55-foot totem pole in front of the Museum. Carved specially for Field Museum by Mr. Norman Tait, a Nishga Indian of British Columbia, the pole was raised in the traditional manner by the public. Chicago Mayor Jane Byrne and other dignitaries were present for the historic pole-raising. Programs included ceremonial dances performed in Stanley Field Hall by Nishga dancers and demonstrations of Northwest Coast craft work.

Funding for "Maritime Peoples of the Arctic and Northwest Coast" was provided by grants from the National Endowment for the Humanities, the National Endowment for the Arts, Chicago Park District, the Barker Welfare Foundation, the Robert R. McCormick Charitable Trust, the Frederick Henry Prince Testamentary Trust, and Marshall Field and Co., in memory of James L. Palmer, former chairman of the Board of Trustees. The Field Museum Women's Board also undertook a major fund-raising drive to support the exhibit, underwrite the carving and installation of the totem pole, and make financiallly feasible events and ceremonies related to the Hall 10 opening.

Another exciting permanent installation, opened on November 21, 1981, was that of the tomb chapels of Unis-Ankh and Netjer-User, Egyptian dignitaries who lived *ca.* 2400-2300 B.C. Walk-in access was provided for the first time to the tomb chapel of Unis-Ankh and viewing access was provided to the interior of the tomb chapel of Netjer-User. Though acquired by the Museum in 1908 and situated on the Museum's ground floor for over half a century, these tomb chapels had never been fully accessible to the visitor. The wondrous beauty of the paintings and inscriptions that embellish their interiors, telling of ancient ceremonies, are at last open to public view. Only one other U.S. museum provides similar access.

Concurrent with the tomb chapel reopening was the installation of a walk-in facsimile of the tomb of Nakht (*ca.* 1453-1286 B.C.), on loan from the Metropolitan Museum of Art. The tomb's interior walls are embellished with scenes from Eighteenth Dynasty Egypt. Curatorial guidance for the hall renovation was provided by Donald Whitcomb, visiting assistant curator, Middle Eastern archaeology.

Two impressive major travelling exhibits marked the biennium. "Hopi Kachina: Spirit of Life" and "The Year of the Hopi," on view June 13 through September, 8, 1981, were shown concurrently. The former was organized by the California Academy of Sciences in cooperation with the Hopi people; the latter was sponsored by Smithsonian Institution Traveling Services (SITES). Both exhibits were supplemented

by items from our own collection. The exhibits were supported in part by Santa Fe Industries Foundation.

The principal special exhibit of 1982 was "The People and Art of the Philippines," on view in Hall 26 from July 17 through December 31. Sponsored by the Museum of Cultural History of UCLA, the show featured 420 artifacts, making it the largest special exhibit of traditional Filipino art to be mounted anywhere since 1905. The materials exhibited included historic Catholic sculpture and paintings, wooden statues, swords, brass jars, basketry, jewelry, ceramics, gold work, costumes, and textiles, most dating between A.D. 1600 and 1900. Like the 1981 Hopi exhibitions, the Philippine show also contained items from the collection of Field Museum, which has the largest collection of Philippine materials outside the Philippines.

A portion of two halls (3 and 9) were remodelled for smaller exhibits. One such exhibit was "The Last and First Eskimos," on view in Hall 9 from October 9, 1982 into January 1983. Featuring the photos of Alex Harris and text of the child psychiatrist Dr. Robert Coles, it documented the European influence during a transitional period in the history of Alaska Eskimos.

The outstanding work of the Department of Exhibition was recognized by a grant from the W. K. Kellogg Foundation to teach exhibit design to people from museums all over the United States. The department also received a grant from the National Endowment for the Arts for the design of an interior graphic and signage system.

Scientific Illustrator Zbigniew Jastrzebski traces 4,000-year-old inscriptions in tomb chapel of Unis-Ankh, recently opened to public view in Hall J.

The Mary W. Runnells Rare Book Room, housing some 6,000 volumes, opened in December 1981, was funded by Trustee and Mrs. John S. Runnells.

The opening of the Library's Mary W. Runnells Rare Book Room on December 2, 1981, was the culmination of many years of planning. The room provides for the first time proper temperature and humidity controls and security that will add many years of useful life to the Library's 6,000 rare volumes. During 1981 work was also completed on the cataloging of this collection. Funding for the new room was provided by Trustee and Mrs. John S. Runnells.

More than 5,000 new volumes were added to the Library's collection during the biennium, a considerable advance over the last reporting period and bringing the Library's total size to 205,500 volumes. In addition to funds provided by the ongoing Cherry Library Fund and the Louis A. and Frances B. Wagner Library Fund, substantial sums were provided by the Rice Foundation in memory of Dan and Ada Rice and by the Grainger Foundation. These funds permitted us to purchase books to support the research work of the curatorial staff that otherwise we would have been unable to afford.

Gifts were a significant factor in the increase as well. Henry Field, a former curator, continued to send materials to be added to the large library he has already donated. Over 100 titles were received from the library of the late Bryan Patterson, also a former curator. Anthony J. Pfeiffer of the Museum's Department of Education gave a collection of works on anthropology and archaeology. Many other donors generously gave one or more volumes.

The collection of books on Japanese art and culture previously given by Cdr. G.E. Boone and Katherine P.

The Founders' Room, reconstructed and refurnished in 1982 through a gift from Dr. and Mrs. Edwin J. DeCosta and the Walter E. Heller Foundation. The portrait above the fireplace is of Marshall Field, the Museum founder.

Boone was cataloged. This collection of over 500 titles has immensely enriched our collection in this area. Cataloging also began on the Donald Richards bryological library, a notable collection in this area of research.

In addition to her duties as reference librarian, Michele Calhoun served as the Library's delegate to LARG (Library/Anthropology Resources Group) and has participated in several of the group's bibliographic projects, including *Serial Publications in Anthropology,* the second edition of which was published in 1981. This volume is a listing of all currently issued periodicals in anthropology and archaeology.

During the biennium 2,500 visitors made use of the Library's Reading Room, utilizing a total of 15,000 volumes. Through the interlibrary loan system, two titles were lent for every one borrowed. Thirty-five percent of the requests came from outside Illinois, 24 percent from outside the Midwest, and 3 percent from outside the United States.

Field Museum was one of the first institutions of its kind to initiate long-range planning. The Museum established, for example, a formal development program in 1969, followed almost immediately by a Capital Campaign and a regular series of five-year budgeting forecasts. The result of this forward planning has saved the Museum from deficit spending while at the same time ensuring programmatic advances.

At the head of the Resource Planning and Development Committee has been Robert O. Bass, retired vice chairman of Borg-Warner Corporation, who has been instrumental in the Museum's fund-raising efforts through a selfless commitment of personal time and business acumen. The increasing strength of the Corporate and Foundation Gifts Division during 1981 and 1982 was attributable to the dedicated efforts of Stanton R. Cook, president of the Tribune Company, who served the division as its chairman during 1981; and George R. Baker, consultant, who provided its leadership in 1982. They enlisted a team of corporate executives, whose efforts brought more than $3.3 million to Field Museum during 1981 and 1982. The individual Gifts Division, under the vigorous leadership of Gordon Bent, partner of Bacon, Whipple and Company, raised almost $2 million during this period.

The result of this coordinated effort was the securing of $5,209,619 during the biennium. Approximately 450 businesses and nearly 4,000 individuals provided this support. The Museum wishes to cite the following donors for exceptional generosity.

Benefactors during the biennium were: Mrs. Leigh (Mary) Block (bequest), Commander and Mrs. G. E. Boone, Mr. and Mrs. DeWitt Buchanan and The Buchanan Family Foundation, the W.K. Kellogg Foundation, Dr. and Mrs. Karl Menninger, Hisazo Nagatani, Mr. Hermon Dunlap Smith*, Amoco Foundation, Chicago Community Trust, The Joyce Foundation, and the John D. & Catherine T. MacArthur Foundation.

Field Museum is particularly grateful to Dr. and Mrs. Edwin J. DeCosta and the Walter E. Heller Foundation for making possible the renovation of the former office of Stanley Field (Board president 1908-64). Rededicated as the Founders' Room in 1982, this new facility represents the continuing role of founders in the Museum's future.

Major Corporate and Philanthropic Foundation Donors: Abbott Laboratories; Allstate Foundation; Arthur Andersen & Co.; Barker Welfare Foundation; Beatrice Foods Co.; Borg-Warner Foundation, Inc.; Commonwealth Edison Company; Consolidated Foods Corporation; Continental Bank Foundation; Dart & Kraft, Inc.; The DeSoto Foundation; The Dial Foundation; R.R. Donnelley & Sons Company; Esmark, Inc. Foundation; F.M.C. Foundation; Field Enterprises Charitable Corporation; Field Foundation of Illinois, Inc.; First National Bank of Chicago Foundation; Ford Motor Company Fund; General Mills Foundation; Harris Bank Foundation; Allen Heath Memorial Foundation; Household International; Illinois Bell Telephone Company; International Business Machines Corporation; International Minerals & Chemical Corp.; Robert R. McCormick Charitable Trust; McGraw Foundation; McMaster-Carr Supply Company; Nalco Foundation; Northern Illinois Gas Company; The Northern Trust Company; Peat, Marwick, Mitchell & Company; Peoples Energy Corporation; Albert Pick, Jr. Fund; S & C Electric Company; Santa Fe Railway Foundation; Dr. Scholl Foundation; Sears, Roebuck & Company; Southern Peru Copper Corporation; Sterling-Morton Charitable Trust; John S. Swift Company Charitable Trust; United Airlines Foundation; United States Gypsum; Walgreen

*Deceased

Among distinguished guests of Field Museum in 1982 was Prince Philip, Duke of Edinburgh on November 8. The occasion of his visit was the November 8 symposium "Tropical Forests: Vanishing Cradle of Diversity," which he chaired. He is shown here with (l. to r.) Mrs. Harry O. Bercher, Mrs. James J. O'Connor, and Mrs. T. Stanton Armour at a reception that followed the symposium.

Benefit Fund; A. Montgomery Ward Foundation; Western Electric Fund; and Arthur Young & Company.

During this period, the newly inaugurated Planned Giving Program, subsidized by a two-year grant from the Joyce Foundation of Chicago, actively encouraged bequests and participants in life income trust. Particularly emphasis has been placed on the Museum Pooled Income Fund. (In a pooled income fund, substantial gifts of donors are commingled in a trust, through which those donors receive lifetime incomes. Upon the death of a participating donor, the remainder of his or her share is transferred to the Museum's General Endowment Fund.) At the end of 1982, the Field Museum Pooled Income Fund held in trust assets valued at approximately $150,000.

During 1981 and 1982, the Endowment Fund was strenghtened by $854,702 from bequests of Museum do nors who wished to ensure the Museum's future as well as to perpetuate their annual giving.

Founded in 1966, the Women's Board continued to be a vital source of strength and leadership for Field Museum. Board members have traditionally been involved in many of the Museum's activities. At the close of 1982, two Women's Board members were serving on the Board of Trustees, fifteen on committees of that group, and many more as volunteers in various Museum departments. Susan E. VandenBosch served as Women's Board coordinator.

Mrs. Robert Wells Carton, a creative and energetic president, completed her term of office at the 1982 annual meeting and was ably succeeded by Mrs. T. Stanton Armour, who continues to bring an innovative and dynamic leadership to the office.

The Women's Board sponsored a great number of important programs during these two years. Two, in particular, were exceptionally noteworthy. In April 1982, under Mrs. Carton's administration, the "Maritime Peoples of the Arctic and Northwest Coast" exhibit opened with the help of the Women's Board. Coinciding with the week-long opening celebration was the successful completion of a major Women's Board project to raise funds to support the exhibit and to make the 55-foot totem pole now to be seen in front of the Museum a reality. A great many board members served on committees organizing the exhibit dedication, a gala preview dinner, and the festive pole-raising which culminated the week of activities.

As board president, Mrs. Armour served as committee chairman for the November 1982 World Wildlife Fund symposium and black tie dinner at Field Museum, with H.R.H. Prince Philip, Duke of Edinburgh as guest of honor. Museum scientists William C. Burger and John W. Fitzpatrick participated in a panel discussion on "Tropical Forests: Vanishing Cradle of Diversity," together with other noted scientists. 500 guests attended the symposium and dinner.

In September 1982 Mrs. Armour announced the next major Women's Board project—raising funds toward the renovation of the permanent Botany exhibit, "Plants of the World," scheduled to open in 1983.

The Field Museum Tours program, which had been reactivated in 1976, involved 415 Members during the biennium in a wide range of tour activities. Tours were offered to Alaska, Ecuador and the Galapagos, the Bahamas (New Providence and Andros Islands), Kenya (with optional extension to the Seychelles), the People's Republic of China, Egypt, Papua New Guinea, the Holy Land, India, Peru-Bolivia, Grand Canyon, and to Baja California and the Sea of Cortez. There were also weekend trips to the Baraboo (Wisconsin) range and an archaeological field trip to southern Illinois.

Most of the tours were led by Field Museum staff, including John Fitzpatrick, Robert K. Johnson, Alan Kolata, Phillip Lewis, Matthew Nitecki, Edward Olsen, Donald Whitcomb, and Bertram Woodland. Dorothy Roder directed the tours program.

Field Museum of Natural History

Statements of Revenues, Expenses, and Changes in Fund Balances
Year Ended December 31, 1982
with comparative totals for 1981

	General fund
Revenues:	
Chicago Park District property tax collections	$2,967,099
Government grants	206,500
Interest and dividend income	2,659,348
Net realized gain on investments sold	
Contributions	1,740,740
Memberships	509,222
Admissions	702,064
Auxiliary enterprises, net of direct costs	406,258
Other	361,644
Total revenues	9,552,875
Expenses:	
Scientific	1,657,901
Scientific support	465,154
Education and exhibition	1,060,383
Administration and museum services	4,760,218
Development, Public Relations, Membership	901,368
Auxiliary enterprises—indirect costs	263,200
Capital improvement expenditures	413,249
Overhead costs charged to grants	(181,048)
Total expenses	9,340,425
Increase in fund balance before transfer	212,450
Nonmandatory transfer—capital improvements	(200,000)
Increase in fund balance	12,450
Fund balances at beginning of year	1,624,019
Fund balances at end of year	$1,636,469

Source: Field Museum of Natural History audited financial statements for the year ended December 31, 1982.

A complex institution such as Field Museum is a major enterprise to operate, as the above financial figures demonstrate. Physically the largest museum in Chicago, the maintenance and operation of nearly a million square feet accounts for the largest category of expense—"Administration and Museum Services." This was up $328,864 from 1981—in large measure a reflection of inflation.

Restricted fund	Endowment fund	Funds functioning as endowment	1982 combined total	1981 combined total
			$ 2,967,099	$ 2,240,513
$1,320,578			1,527,078	1,754,910
554,141	$ 80,565	$ 438,327	3,732,381	3,595,755
	905,931	2,843,385	3,749,316	1,121,247
1,637,479	5,000	184,046	3,567,265	2,872,102
			509,222	561,814
			702,064	709,859
			406,258	201,727
37,558			399,202	643,807
3,549,756	991,496	3,465,758	17,559,885	13,701,734
823,044			2,480,945	2,161,556
16,825			481,979	522,596
948,124			2,008,507	2,094,076
33,276			4,793,494	4,464,630
4,771			906,139	1,016,044
			263,200	270,682
839,668			1,252,917	904,977
181,048			—	—
2,846,756			12,187,181	11,434,561
703,000	991,496	3,465,758	5,372,704	2,267,173
200,000			—	—
903,000	991,496	3,465,758	5,372,704	2,267,173
3,055,726	7,805,129	24,311,107	36,795,981	34,528,808
$3,958,726	$8,796,625	$27,776,865	$42,168,685	$36,795,981

Basics such as energy, building repair and maintenance, security and visitor services, printing, postage, telephones, supplies, and housekeeping comprise the bulk of the Administration and Museum Services expense category.

STAFF PUBLICATIONS

The list below is comprised of the scientific publications of the Field Museum curatorial staff for the years 1979-82. As in other years, staff members have also published reviews, abstracts, encyclopedia entries, and numerous popular articles and books.

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LEONARD, ANNE

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TOURS FOR MEMBERS

COSTA RICA

January 14-27, 1984

$2,000.00

(includes round trip air fare and many meals)

Visit San Jose, Cartago, Port Limon, Puerto Viego, Port of Puntarenas, Monteverde Forest Preserve and Cloud Forest, and more. This tour will give you an opportunity to explore in depth the plants and edible fruits of this country plus many opportunities for photographing.

Dr. William C. Burger, curator and chairman of Field Museum's Botany Department, has concentrated his attention on Costa Rica and has helped produce several volumes for the Flora of Costa Rica project. He has been on nine collecting trips to Costa Rica, and visited many areas of the country. In addition to his interests in flowers and floras, Dr. Burger has been an avid amateur photographer for more than 30 years. Also, Tom Economou, horticulturist and botanical plant explorer will join our group as co-leader. We invite you to join us.

ANCIENT CAPITALS OF CHINA

October 6-28

$3,975

Beijing, Xian, Luoyang, Zehngzhou, Kaifeng, Suzhou and Shanghai. This itinerary includes the most significant sites of early Imperial China and will give you an opportunity to explore in depth the civilization which characterizes one of the earth's longest-lived societies.

China's influence on our lives is now so well established as to go almost unnoticed. Take this magazine; the paper, the ink in which it is printed—indeed, the printing process—all owe their origin to the Chinese. Our whole lifestyle seems bound up in Chinese accomplishments: the magnetic compass, the manufacture of steel, machinery for weaving, milling and casting metals, deep drilling, paper money, silk spinning, and porcelain are all products of Chinese inventiveness and technology.

Our tour of this vast and versatile land will include the time-honored treasures of Old China given an added depth by the progressive achievements of New China. This itinerary includes side trips to the Great Wall and the Ming Tombs and the famous Longmen Caves near Luoyang. Also it will include an in-depth visit to the recent archeological finds of the Qin Shi Huan Di at Xian.

Our lecturer, Phillip Woodruff is experienced with travel in China, having led four previous tours for Field Museum. He speaks fluent Chinese and has an excellent rapport with the Chinese guides. This year he will have another extra dimension to bring to our tour as he is currently living and working in Beijing, where he will meet our group upon arrival.

If a visit to China is in your travel plans why not make it this year while China remains a place that is different, unexploited, and seemingly unspoiled. Your visit to China will be the life-time experience that it sould be.

We have a few spaces left for a group not to exeed 28 people. For further information, please call Field Museum Tours.

STEAMBOAT CRUISE TO STARVED ROCK

October 12-14

Help keep alive a way of life that goes back over a hundred years to when steamboats were the fastest, most comfortable means of transportation. Join us for a one-day cruise on the *Str. Julia Belle Swain*, the last steamer on the Illinois River, which we will board in Joliet at 9:00 a.m. October 12. As we float along toward our destination (Starved Rock), we'll enjoy the picturesque scenery and several riverfront towns. You may become so relaxed watching the islands and sandbars slide by that you may catch a cat-nap in your deck lounge chair.

We will spend two nights at the beautiful rustic Starved Rock Lodge where we will enjoy nature walks, short talks, a slide show, and good food. Friday morning, October 14 we will return to Chicago by bus, stopping en route at the birthplace of Ronald Reagan in Tampico, Reagan's boyhood home in Dixon, the John Deere Historic Site in Grand Detour, "Black Hawk" statue at Lowden State Park, and the Stillman Valley State Monument.

Our leader is John Clay Bruner, Field Museum's collection manager of vertebrate paleontology. For further information please call or write Dorothy Roder, Field Museum Tours. (Telephone 312/322-8862).

BARABOO, WISCONSIN

October 1-2

$125.00

There is no lovelier or more diverse vacationland in America than the state of Wisconsin—scenic country roads, rolling dairyland, stunning views from the palisades and immense bluffs. Best of all the location is convenient—Baraboo is just about 2½ hours from Chicagoland.

Come and join us for a mini-vacation to the Baraboo range, 15,000-year-old heritage of the last glacier to cover Wisconsin. The background is fascinating; you will explore the gorges, gaps and moraines of the hills cut by erosion and the Wisconsin Glacier under the expert guidance of our eminent and amiable geologist, Dr. Edward Olsen. His lectures alone are practically worth the price of the entire weekend to say nothing of the wonderful outdoors experience.

The price includes transportation by deluxe motor coach round trip from Field Museum, all meals, overnight accommodations and lectures.

We have budgeted the price of this tour as low as possible to make it within reach of almost anyone interested in this special tour. Therefore, operation is contingent on an enrollment of at least 25 people. Please sign up early to ensure your reservation.

KENYA

WITH OPTIONAL EXTENSION TO THE SEYCHELLES

$3,395

Seychelles Extension $1,350

September 10-28, 1983

You are invited to join us for an exciting 19-day safari to East Africa accompanied throughout by Audrey Faden, experienced lecturer and tour guide, plus local guides. Game is still plentiful and this tour is scheduled to coincide with the animal migration. It will be Spring in Kenya. The time to go is now! A trip to Kenya is a vacation that never ends. We hope you will make your reservation now.

SAILING THE LESSER ANTILLES ABOARD THE TALL SHIP "SEA CLOUD"

January 26-February 4, 1984

Our itinerary offers a superb sampling of the best of the Caribbean—Antigua, St. Barts, Saba, Martinique and Iles des Saints. With the professional leadership of Dr. John Fitzpatrick, a Field Museum scientist, you will see and experience much more than the conventional sightseer. Dr. Fitzpatrick, is an excellent tour lecturer, and your trip will be greatly enhanced by his lectures and field trips.

We hope you will be able to join us on this incredible voyage. Price range, contingent on cabin selection, $3100/$5,100 per person (includes round trip air fare from Chicago, hotel accommodations in St. John's, Antigua, full board while sailing on the *(Sea Cloud)*.

Plants of the World Photography Competition 1983

The exhibit "Plants of the World" will open at Field Museum on September 24. In celebration of flowers and the exhibit opening, the Museum announces the Plants of the World Photography Competition, cosponsored by Field Museum, Standard Photo, Helix Ltd., and Astra Photo Service. All members who are photographers (regardless of residence) as well as non-member photographers in the Chicago metropolitan area may submit slides of flowers and plants without any further restrictions on subject matter—any subject in the realm of the plant kingdom is acceptable. The competition is divided into two age groups: Group I entrants must be under 17 years old as of August 1, 1983; Group II entrants must be 17 years or older as of August 1, 1983. To enter, complete the form below. Slides must not be mounted in glass. Only original slides that have not been published are acceptable. Indicate the proper slide orientation for projection with a dot in the upper right corner of the mounting on the non-emulsion side, together with your name and slide title. Please make your check payable to Field Museum.

Winning photographs will be featured in the October *Bulletin* and in Gallery Nine, September 23 through October 11. An individual membership to Field Museum accompanies the award. The Museum reserves the right to publish, exhibit, and use for promotion the winning photographs. The decision of the judges is final.

Six Honorable Mentions will be on exhibit and receive memberships. Winners of Certificates of Selection will also be on exhibit.

Judges: Dr. William Burger, Chairman, Department of Botany, Field Museum; John Alderson, award-winning commercial photographer, columnist and critic, Chicago *Sun-Times*; and Ron Bailey, award winning photographer, Chicago *Tribune*.

Eligibility

Competition is open to photographers in the Chicago metropolitan area (Cook, Lake, McHenry, Kane, DuPage, and Will counties) and *all* museum members. Employees of Field Museum and the cosponsor and their immediate families are not eligible.

Entries

A completed entry form and entry fee of $5.00 must accompany each entry of one to three 35mm color slides. Entrants may submit three entries of 1 to 3 slides each (a maximum of 9 slides for the contest).

Entry forms are also available at Field Museum's information Desk. The form may be photocopied for additional entries.

Delivery

Entries will be accepted between August 1 and 15. Mail to:

Field Museum Photography Competition
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605

Pack entries *with care*. Field Museum assumes no responsibility for damage or loss in shipment, delivery, and/or return.

Returns

Enclose a self-addressed, stamped envelope for return of entries. Entries not so accompanied will be discarded. Field Museum assumes no responsibility for damage or loss in return mail.

Awards

- **Grand prize:** Minolta XD11 camera with 50mm 1.7 lens; photo will also appear as cover illustration for October 1983 Field Museum *Bulletin*
- **First prize:** (Group I) Helion all-weather rubber-coated 8x10 binoculars; (Group II) weekend trip to Horicon Marsh to view Canadian goose migration.
- **Second prize:** (Group I) $50 worth of film processing; (Group II) $100 worth of film processing.
- **Third prize:** (Group I) Helix 101 flash unit; (Group II) Kamrac camera bag.
- Certificates of selection.

Entry Form: Plants of the World Photography Competition

This form must accompany all entries. Use the guidelines above as a checklist.

Name_____ Daytime phone_____

Address_____
street

_____
City State Zip Code

Group I____ Group II____

Enclose $5.00 check or money order payable to Field Museum of Natural History.

I understand and agree to the conditions of the contest as stated in the above guidelines.

Signature: _____ Date: _____

FIELD MUSEUM OF NATURAL HISTORY BULLETIN

September 1983

PLANTS OF THE WORLD

Opens Saturday, September 24
Members' Preview Friday, September 23

Field Museum of Natural History Bulletin

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COVER

Model of the flower of Lent (Tibouchina granulosa). *Models of several hundred members of the Plant Kingdom, from algae to orchids, will be on permanent view with the opening of Hall 29, "Plants of the World," on September 24 (Members' preview Sept. 23). See "The Botanical World in Replica," p. 5. Photo by Ron Testa.*

EVENTS

Special Events

"Travels of the Victory Garden" with Bob Thomson
Saturday, September 24, 2:00pm
James Simpson Theatre

Bob Thomson, host of the popular, nationally syndicated television gardening program "The Victory Garden," presents a behind-the-scenes look at the travels of the Victory Garden. Join us as we travel to the gardens of Costa Rica, England, Holland, and Hawaii. Following the lecture, you can question the expert about your home garden.

Members: $3.00
Nonmembers: $5.00

Funded in part by the Ray A. Kroc Environmental Fund. Order tickets with the attached coupon. Fees nonrefundable.

Plant Life in the Tropics: Symposium
Sunday, September 25
1:00—4:00pm
James Simpson Theatre

Tropical forests are being destroyed so rapidly that much of the diversity of life on earth will disappear during most of our lifetimes. By the end of the century three out of every five people in the world will be living in ecologically devastated tropical countries. Their futures, and ultimately ours, depend on the choices we make over the next decade. Join us as Drs. Peter Raven, director of the Missouri Botanical Garden; William Burger, chairman, and Michael Dillon and Timothy Plowman, assistant curators of Field Museum's Department of Botany, using graphic slides from their fieldwork, explore with us how the preservation of tropical organisms affects the welfare of humankind.

Members: $6.00
Nonmembers: $8.00

Order tickets with the attached coupon. Fees nonrefundable.

A Celebration of Plants of the World
Saturday, September 24
1:00—4:00pm

Celebrate with Field Museum the beauty and diversity of nature's plants and flowers. Chicago area botanists, gardeners, and plant lovers present demonstrations, displays, and exhibits of live plants and flowers. Sample herbal teas, find out how to best design your small garden space, get your fingers dirty learning the do's and don't's of planting fall bulbs or create a beautiful array of dyes from natural plant materials. View the fascinating art of **Ikebana** (Japanese flower arranging), learn how decorative gourds are used around the world or find out how and where to plant trees in Chicago.

Free with Museum admission. For a complete schedule of the day's events, send a self-addressed, stamped envelope.

Highlights

"Unlocking the Secrets of the Sphinx"
with Mark Lehner, Field Director,
The Sphinx and Isis Temple Project
Sunday, September 18, 2:00pm
James Simpson Theatre

For centuries, the world has wondered about the Sphinx, and questioned why it was built. Mark Lehner is currently Field director for the first scientific study of the Sphinx. This study has shattered conventional wisdom about how and why the Sphinx was built. It reveals possible astronomical significance, explains the methods and materials used in construction and comments on the significance of the Sphinx in ancient Egyptian society. Join us for this fascinating, illustrated lecture. Order tickets with the attached coupon.

Members: $3.00
Nonmembers: $5.00
Fees nonrefundable

Family Feature
"Checagou: Home of the Potawotomi"
Saturday and Sunday, September 10 and 11, 1:30pm
Hall 6, near Pawnee Earth Lodge

Chicago is celebrating its 150th birthday this year. Journey back with Field Museum to those early days before Chicago was born. Relive the days when "Checagou" was home to the Potawotomi Indians. Watch a puppet show about life as a young Potawatomi boy in "Checagou." After the puppet show, children can make their own Potawatomi puppet.

Edward E. Ayer Film Lectures

Travel the world on Thursdays in September and October at 1:30 pm in James Simpson Theatre. Admission free. Doors open at 12:45 pm. Members must bring their cards for priority seating privileges.

- September 8: "The Great Lakes," with Frank Karney
- September 15: "Europe's Teacup Countries," with Frank Klicor
- September 22: "Mexico," with Howard and Lucia Meyers
- September 29: "Sweden," with Ric Dougherty

Weekend Programs

Free tours, demonstrations, and films are offered each Saturday and Sunday at Field Museum. September highlights include:

September
3 12:00 noon *Dinosaur Lifestyles* (tour) See reconstructed skeletons of gigantic dinosaurs. Contrast old and new ideas about dinosaurs' appearance, behavior and environment.
10 11:30 a.m. *Ancient Egypt* (tour) Explore the traditions of ancient Egypt from everyday life to myths and mummies.
11 12:30 p.m. *Museum Safari* (tour) See shrunken heads from the Amazon, mummies from ancient Egypt, and big game from Africa.
17 1:00 p.m. *"Life In A Tropical Rain Forest"* (film, 30 min.) View the great variety of exotic life in three different types of tropical rain forests.
2:00 p.m. *Malvina Hoffman: Portraits In Bronze* (lecture/tour) Enjoy this elegant study of the races of man by the celebrated sculptor.
18 1:00 p.m. *"Baobab: Portrait of a Tree"* (film, 27 min.) Learn the mysteries of the giant baobab tree. The baobab provides a microenvironment which supports the lives of innumerable animals.
25 12:30 p.m. *Museum Safari* (tour)

See complete program schedule and location listing in *Weekend Passport* (pick up at any Field Museum entrance). Programs partially funded by the Illinois Arts Council.

Registration

Please complete coupon for your program selection and any other special events. Complete all requested information on the application and include section number where appropriate. If your request is received less than one week before program, tickets will be held in your name at West Entrance box office until one-half hour before event. Please make checks payable to Field Museum. Tickets will be mailed on receipt of check. Refunds will be made only if program is sold out.

Program Title	Member Tickets #Requested	Nonmember Tickets #Requested	Total Tickets #Requested	Amount Enclosed
			Total:	

Name

Street

City State Zip

Telephone Daytime Evening

For Office Use:

Date Received **Date Returned**

Return complete ticket application with a self-addresed stamped envelope to:

Public Programs: Department of Education
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605-2497

Have you enclosed your self-addressed stamped envelope?

The Botanical World in Replica

The Story of Field Museum's Astonishing Collection of Plant Models

by Michael O. Dillon and Beverly Serrell

Destruction of the world's tropical and subtropical forests is occurring at an accelerating and alarming rate; more than 35 acres of forest are being destroyed every minute in logging activities and land clearing for agriculture. Much of this destruction is due to profit-seeking ventures, but a lack of appreciation for these ecosystems is contributing to the steady loss of one of our major resources. Because of the general inaccessibility of tropical forests, few people have visited them, though many have had brief glimpses in botanical gardens or while viewing nature programs on television.

The inadequacy of methods for exhibiting plant forms in museums has been a major obstacle to developing this education medium—one that has great potential for increasing public awareness and appreciation of plant life. Because most museums lack the resources for making plant models, it is generally not feasible for them to produce satisfactory exhibits of plant forms as they appear in nature. Chicagoans are very fortunate, however, in having an extensive botanical model collection at Field Museum.

Plants of the World, one of the Museum's four largest halls, will allow visitors a unique opportunity to examine in model form many examples of tropical plants as well as temperate plants familiar to Chicago area residents.

On November 1, 1893, barely six weeks after the founding of Field Museum (then called Columbian Museum of Chicago), Charles Frederick Millspaugh became the Museum's first curator of the Botany Department, a position he continued to hold for nearly 30 years. Around Ithaca, New York, Millspaugh's birthplace, he had been known as the "boy naturalist." Though he had completed training to enter the medical profession, he abandoned this to pursue his consuming interest in botany. Under Millspaugh's guidance, the Botany Department took shape, his special interest in economic botany and tropical plants lending a direction and influence that continues to this day.

The Museum had acquired from exhibitors at the

Preparator Emil Sella (1944) puts finishing touches on model of Welwitschia. 80027

Michael O. Dillon is assistant curator of vascular plants, Department of Botany; Beverly Serrell served as educational consultant, Department of Exhibition. Dr. Dillon was curator in charge of the exhibit.

Plants of the World

Members' preview: Friday, September 23
3:00 to 8:00 pm

Public opening: Saturday, September 24
9:00 am to 5:00 pm

Model of water hyacinth, Eichhornia crassipes

The Illinois woodlands scene is one of five large botanical dioramas completed between 1933 and 1941.

Columbian Exposition a formidable collection of timbers, oils, gums, resins, fibers, fruits, seeds and grains; not included in this assemblage were living plants, which Millspaugh viewed as a major deficiency. So around 1896 he originated an exhibit concept that would ultimately solve this problem as well as revolutionize the development and production of botanical exhibits.

Millspaugh hired B.E. Dahlgren in 1909 to head a facility for producing plant models of exacting fidelity. An accomplished model-maker with professional experience in making dentures, Dahlgren was accustomed to working with wax, glass, and celluloid. The first plant reproductions completed by Dahlgren's team included the breadfruit and papaya models—the beginnings of one of the most impressive collections of plant models in the world.

From the start, these creations sparked the interest of the public as well as scientists. The story is told of a distinguished foreign scientist being escorted by Millspaugh through the botany halls. Upon seeing some of the plant models, the visitor remarked, "It is very nice, but you cannot conduct a museum so! You

Model of Sanchezia noblis

Above: *Reproduction lab worker prepares milkweed model (about 1915).* Below: *Preparator John Millar poses in 1920 with coconut palm collected in Florida. Specimen was subsequently copied in reproduction lab for museum's model.* 86787 40327

Cannonball tree model, the largest in the Museum's collection of plant reproductions. 49337

cannot put in a plant, and when it wilts and fades put in another! It cannot be done."

"But these plants," replied Millspaugh, "do not wilt or fade. They last forever. They are artificial."

The scientist looked closely and exploded. "No! It cannot be! Yet, it is! My, but this is wonderful!"

In addition to models of large flowering trees, herbs, ferns, and fungi, many tiny, intricate glass models of diatoms and algae were also constructed. Millspaugh termed these displays the "substitute for the microscope in museum installation." Indeed, the viewer can enjoy in these minute forms a singular beauty that is usually the exclusive viewing pleasure of the microscopist.

The plant model shop was initially located several miles from the Museum, on Jefferson Street, and during its first five years, the staff was busy creating models of plants from the tropics and subtropics, because these areas offer the greatest diversity of species. Expeditions continued through the years to obtain plants from regions such as Jamaica and Guiana (Guyana, Surinam, French Guiana, and neighboring regions) that are especially known for their species richness. In 1914 the shop was closed for two years due to the impending hostilities of World War I; but in 1916, before the United States entered the war, Museum President Stanley Field personally undertook the financial responsibility of reopening the shop. It became very active, producing hundreds of models representing plants from all over the world. During a seven-month period in 1919-20, the lab was moved to Miami, Florida, to continue the production of tropical models. At first designated the Sara C. Field Laboratories in recognition of the support of Mrs. Stanley Field, the name of the facility was changed in 1922 to that of her husband.

The depression of the early 1930s had the effect of budgetary cutbacks at the Museum, but the Work Projects Administration (WPA) gave the institution new life. Between May 1935 and June 1941 nearly 1.5 million man-hours were contributed by WPA workers, a share of this in the reproduction lab. During this period many of the spectacular ecological settings were completed, including the alpine diorama and that of the

giant water lily. During World War II, the production of models again was curtailed, but with the beginning of the postwar period, the staff was enlarged and production again increased. It was also during this period that the greatest effort was made towards the improvement of existing displays by replacing photographs of plants with models.

The new exhibit is designed to present a general view of the plant kingdom, including fossil as weli as living plants, algae to orchids, with more than 600 species represented. The flowering plant models comprise the bulk of the collection, and many of these have been chosen for their importance to mankind or for some other particularly interesting feature. Also included are representatives of nearly 30 percent of the approximately 370 plant families, with examples of all major taxonomic groupings. Most of the models are life size and represent the entire plant. The cannonball tree and banana plant models, each over six feet tall, show the plants in their natural "poses"—planted in the soil, with dead as well as new leaves on the plant.

Before a model was constructed, detailed watercolors were painted, field notes taken, and photos made of living plants in their natural habitat. The collected specimen was dissected and plaster of paris molds were made in the field of plant parts, such as leaves and flowers, while still fresh. These preliminary molds were subsequently used in the laboratory in the preparation of glass or metal molds. Plant material, preserved in fixative, was stored in jars until required for study during the final stages of model preparation. Often, large trunks, stems, or fruits were shipped back to Field Museum at considerable expense and effort.

The materials of which the models were fabricated changed over the years. In the early days of the laboratory, latex, glass, wire, and various waxes were the standard building materials. After World War II, plastics became more commonly used. Techniques for compression and injection molding, which produced lifelike results, were developed. The most exquisite examples of the laboratory's work may be seen in the 65 enlarged floral model cross-sections and in such floral details as long, filamentous stamens. Regrettably, much of the information gained in the laboratory about pigments and production techniques was never recorded and is now lost.

With time fast running out for many of the world's tropical plant habitats, *Plants of the World* will serve students, educators, and the public as a source of beauty and interest; and, it is hoped, will lead to better protection and management of our natural resources.□

Plant models. *Above:* Medinilla magnifica; *left:* Bixa orellana.

Bryophyte Collecting in the Bolivian Andes

Letters from Field Associate Marko Lewis

Great museums are built around great collections. The exhibits and research activities may be better known, but the central responsibility of Field Museum is housing millions of specimens. The museum tradition probably began with the curio cabinets of well-to-do collectors some three hundred years ago, a tradition that was transformed as early scientists, like Linnaeus and his colleagues, brought an almost religous zeal to collecting and classifying the living world. With the further development of science, many corners of the globe have been assiduously collected and our museums curate the harvest of these many years. While some nations have restricted the export of their natural and cultural heritage, in many areas the business of collecting in the field goes on apace.

But why continue collecting so busily? Of many living things, especially the very small, we have sampled only a small portion of the earth's diversity. There remain areas of the world where little or no collecting has been done; this is especially true in the tropics, where much of the world's living diversity resides. Also, while we may have a specimen or two of a particular species, this may not be enough to tell us about its relationships, and utterly insufficient for thinking about its ecology or geographic range. As in so many human endeavors, more seems to be a lot better when trying to understand the diversity of life.

One of our field associates, Marko Lewis, is off in Bolivia collecting mosses and liverworts (collectively called the bryophytes). He is not a professional botanist but rather an avid amateur. His interest in this group of plants began while living in an isolated cabin in Alaska and grew to the point where he made a collecting trip to the high mountains of Bolivia in 1979. This land-locked country of mountains, deserts, and jungles proved so fascinating that Marko returned late last year with the aid of a National Geographic Society grant. This grant was developed by John Engel, our curator of bryophytes who has guided Marko's botanical work for over nine years.

A man of keen intelligence, friendly manner, and the dedication of a true collector, Marko is also extremely frugal in his living habits and this has made it possible for him to work in remote areas with minimal funding. We are very fortunate to have him collecting for Field Museum. Marko has sent us a number of letters about his collecting activities over the last half year. Herewith, a little sampler of what it's like collecting in far-away Bolivia.

—William Burger, chairman, Department of Botany.

December 1982. I made and processed about 600 collections the first half of this month, and will go out again after Christmas. We managed to roll the University's Jeep over on its roof on the way back from Calambaya and no one was hurt but it made a mess out of my gear and broke the base of my stereoscope (I glued it back together). Spent a very cold evening in Milluni at 4800 meters [15,750 feet elevation], because after we rolled the jeep back on its wheels it wouldn't go and my camp outfit wasn't along. I will tell you that I'm now kind of afraid of these roads.

January 1983. I spent most of last week preparing specimens collected before Christmas. I am now packing to make a trip down one of these trails: Ancoma-Tipuani, or Yani-Mapiri, or Consata-Mapiri. This will take me through dry valleys into various humid forests. They are all 3 to 7 day walks. From Mapiri I may work some on the Alto Beni if I can get a small boat or hire one to take me into the Serrania Chepite just north of Puerto Pando. There should be some good forest left in this area. I am in good health at last (I had mild bronchial pneumonia through most of late November-December).

If you don't hear from me by mid-March I'm probably lost in the jungle somewhere.

February 1. I just completed a transect of the Andes from Titicaca down through Illampo and down through all the altitudes (3600-700m—11,800-2,300 feet) to Mapiri at 600m. This was a twelve day slog, mostly on foot, the last four days on a foot trail through the selva salvaya with a 25 kilogram backpack (full of specimens). I collected 499 specimens.

I'm completely covered with itchy bug bites left by invisible insects which seem to imperviate my every protective device. My gear received a good testing and for tropical forest-trail travel was found wanting....The trouble is the heat, the fact that the trails are sopping wet, the overhanging branches and thick brush one has to crawl through, and the insects (in-

Steve Dercole, assistant in cryptograms, Department of Botany, views baskets of Bolivian bryophyte specimens collected and shipped to the Museum by Marko Lewis. Photo by Ron Testa. 83239

cluding "killer" bees that sting at the slightest provocation and are found at every nice camp-type clearing of which there are few and far between, often none flat enough for a tent). So I'm going to reoutfit for my next forest excursion. The tent is allright but it has to be sealed up to keep out the bugs and is sweltering. All nylon gear gets clammy and disgusting. I may sew some cotton gauntlets on my tennis shoes, since socks are horrible smelly wet devices. Maybe thin cotton socks would do.

I'm drying my specimens today in the shade near a little river where people from Mapiri come to bathe and wash clothing. I also washed my clothing (which are permanently stained) early in the morning. Watching the girls bathe has been much more interesting than watching the mosses dry.

February 11. I have spent the last week collecting the north Yungas between Corovico and Chuspitata, elevations of 1800 to 3000 meters (5,900-9,840 feet). Collecting conditions are bad; it is raining more or less incessantly and the trails in the high cloud forests are kneedeep in mud. Within these altitudes there appear to be three distinct bryophyte communities (or zones). Below 1900m. most of the terrain is cultivated in coffee and the trees used for shade have a small but distinct community of bryophytes. Their growth form, quite adnate to rock and bark, is suggestive of the drier lowland forests (at 700-1000 meters). At 1900 meters there survives some shrubby cloud forest, which becomes a forest of trees 10 meters tall at 2400m elevation. This is very mossy (or should I say liverworty?). The transition from low cloud forest bryophytes (here mostly liverworts) to cold cloud forest bryophytes occurs at about 2400-2600 meters. Above this line the flora completely changes. Sphagnum is abundant and there is a community of "giant" mosses which I haven't found elsewhere.

The dept. of La Paz is very rich in bryophytes and without any trouble or loss to science a year could be spent in Dept. La Paz alone. I'm beginning to feel as if I'm not even scratching the surface of the flora. Everytime I get to a new bend in the trail five species I've never seen before appear. I have a serious problem with the weight of equipment plus the weight of the wet bryophytes. In the cloud forest, a day's collecting *easily* weighs 25 lbs. wet. To dry, they need to be packed out to a drier climate. I am inventing a new wet tropical collecting system.

March. I've decided to buy a Jeep if I can find one for less than $1500. The transportation system in Bolivia has fallen apart to the point where I'm losing a great deal of time as well as my health trying to deal with it. Within my project there are so many things I have to

do that I can't successfully carry the gear and lab equipment needed on my back. What's happened since 1979 is that the *transportistas* need to pack the trucks so people are literally hanging onto the sides so they can pay for the gas and minimal repairs, with government controlled fares. The crowding, aside from the discomfort, means that once they leave the city they no longer stop along the road to pick up people like botanists who happen to be collecting in the *campo*.

April. The Jeep has greatly improved my ability to collect but has added to my frustration in that now I can stop anyplace that looks good and collect, so it takes forever to go any distance. The flora changes every kilometer and I don't feel I've been able to really get a detailed picture of anything, just surface scanning each area for a half day to two days....You have no idea how many valleys there are and each one (below the Sub Andean vegetation) is quite unique. There are so many species that it's maddening. I can't get a bead on it—all the rain shadows, the valleys creep this way and that, the flora constantly changes in every direction, the species vary all over the map, not only altitudinally but with varying humidities (and latitudes? who knows).

May. I am presently waiting out a rainstorm in a deep canyon between Illamani and Muramata (two of Bolivia's largest icefields). I bought an old Land Rover last month and it is sufficient in size to have put a foam mattress in the pickup bed, so I'm laying in back. I got wet collecting this morning. I'm working my way down to the Ceja de Montaña habitat but I've had nothing but horrid weather. I climbed over Turquesi Pass and ended up in a snowstorm, ran out of kerosene and hiked back over the pass; three days and only about 100 specimens to show for the effort. I had lugged all my photo gear but couldn't set up to snap my pictures. I was attacked by wicked winds that shake the camera as well as the moss leaves. Oh well. Now I'm a bit worried that the rain will wash out the damn track I brought the jeep down.

One other thing, I broke a meniscus [cartilage] in my knee in Yungas de Totora. I was laid up *three* weeks. The doctor wanted to operate. Both my knees are weak but I wear elastic bandages and am getting around (slower) alright. For 2 or 3 days my leg was stuck like like this:

I just kept off it and it seems to have healed but walking downhill with a pack is a real chore. I have to be very careful not to slip or jar it too much. I also have recurring bouts of intestinal parasites; usually I could probably open a natural gas plant. I live in one of the poorer sections in La Paz in a real nice place (a residential/gringo hotel) with a balcony, two rooms and a bathroom (shared). I'm looking for another place (cheaper) but haven't found anything yet. I spend about 50% or more of the time in the field but a lot of time is wasted in road blockades, broken knees and horrible (always) weather. I've barely ever had a trip with liveable weather. The best weather is in La Paz or places like Sucre and Cochabamba where there aren't any bryophytes. The Ceja, Yungas, and alpine habitats are either freezing humid or near-freezing humid, lots of rain always and nary a ray of sunshine. The deserts (interandean dry valleys) are blistering hot and not so mossy. The tropical lowlands are either hot and sticky with millions of biting creatures or pouring down rain like Noah's flood. Right now I'm freezing my ass off in the rain, half soaked. Maybe I'll fix coffee. □

In his latest letter, Marko outlines a proposal to fund an additional year's collecting in Bolivia.

FIELD BRIEFS

Group Tours Offered for "Treasures from Shanghai," Exhibit Opening November 5

Visit Field Museum this fall, and journey back in time through 6,000 years of Oriental culture. "Treasures from Shanghai: 6,000 Years of Chinese Art,", a superb new exhibition from the Peoples' Republic of China, was organized specifically for the American public by the Shanghai Museum and the Asian Art Museum of San Francisco. Previously inaccessible to Western audiences, the exhibition is unparalleled in aesthetic and historical distinction.

More than 200 exquisite objects reflect the varying techniques and styles of Chinese artists in a multitude of forms—sculpture, painting, ceramics, bronzes, jades. These treasures span the cultural eras of ancient China, from prehistory through the 20th century, and offer viewers a visual feast of archeological materials and decorative arts, including Imperial Sung drinking vessels, T'ang ceramic horses, neolithic jeweled axes, Ming lacquer furniture and Qing landscape paintings. Especially impressive is a procession of 66 glazed pottery honor guard figurines excavated from a Ming tomb, and a magic mirror of bronze whose surface reflects the decorative design on its back.

Field Museum is one of only four museums selected to host this major event, and will devote to "Shanghai" over 14,000 square feet of exhibit space in galleries immediately adjacent to our own highly regarded Asian collection. The exhibit will close on Feb. 14, 1984.

Special arrangements have been made to accommodate group viewings of "Shanghai." Such viewings may be scheduled during regular Museum public hours, 9am to 5pm, daily except Thursday (30 person minimum); or during nonpublic hours, on Wednesdays only, from 6 to 9pm (50 person minimum). The admission fee during public hours for group members will be $3, regardless of age; the admission fee during nonpublic hours will be $6, regardless of age.

To provide an expanded perspective of "Treasures from Shanghai," an optional lecture will be available to such groups at a cost of $75. This program will examine the cultural and historical background behind the objects on exhibit and compare the visions and techniques of Chinese artists with those of Western artists.

Audio tours will be available to groups at a discounted rate. To be eligible for the discounted price of $1.50 per person, the *entire* group must reserve audio tours in advance.

Groups visiting "Treasures from Shanghai" may also wish to make special arrangements for breakfast, lunch, or dinner, served in a private dining area.

A brochure on visits by groups of 50 or more to "Treasures from Shanghai" is available by phoning the office of General Services, at (312) 322-8864, or by writing the office at Field Museum, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.

American Association of Museums Annual Meeting Attended by Field Museum Staff Members

Of all the organizations that the Museum relates to, none is more important to its professional life than the American Association of Museums. At the annual meeting of the AAM, this year in San Diego, the Museum was represented by staff who were involved in a broad array of activities. The AAM is governed by a council composed of elected members, elected regional representatives, chairmen of standing committees, and heads of affiliate organizations.

Two Museum staff serve on the AAM Council, Carolyn Blackmon as chairman of the Education Committee and Lorin Nevling as elected regional representative and as president of the affiliate organization, Association of Science Museum Directors. Field Museum President Emeritus E. Leland Webber serves the AAM as chairman of the Legislative Committee. Other working groups within the AAM include the Accreditation Committee, in which Director Nevling will serve as senior examiner, and the Trustees Committee, in which Trustee William Swartchild has carried a strong leadership role. An *ad hoc* working group under the aegis of the Legislative Committee met to discuss interaction between museums and the National Science Foundation. Blackmon and Nevling are members of this group.

The AAM is composed of six regional conferences, Field Museum being a member of the Midwest Museums Conference. Three Field Museum staff members serve on the MMC Council: Blackmon, Gustav Noren (editor of MMC Quarterly), and Nevling. The MMC council met during the course of the AAM meetings.

The core of the meeting is the presentations and panel discussions. This year the staff participated actively as follows: Webber chaired the panel "AAM Legislative Update"; Thomas Sanders chaired the panel "Interfacing Development with Membership"; Blackmon was a panelist on "Promoting the Museum's Permanent Exhibits: New Approaches to an Old Challenge"; Nevling was one of the protagonists on "The Inseparable Activities of Research and Exhibition: Point and Counterpoint." Other staff attended sessions and panel presentations.

One evening the participants toured the museums and galleries of La Jolla. One of the stops was the Mingei International Museum of World Folk Art, where Field Museum's award-winning traveling exhibit "Patterns of Paradise" was being featured. At the exhibition three "generations" of Field Museum directors met for the first time, Clifford Gregg (1937-1962), E. Leland Webber (1962-1980), and L. Nevling (1980-present).

The Museum won honors in the 2nd Annual AAM Design Competition, including highest honors for a brochure advertising the book *Endodontoid Land Snails from Pacific Islands*, by Alan Solem, curator of invertebrates, and awards of merit for *Courses for Adults* and *E. Leland Webber Hall* brochures.

Bequests Are Welcome Gifts

A gentleman with fond childhood memories of his frequent visits to Field Museum recently notified the Museum's Planned Giving Office that he has provided for a $50,000 bequest to help ensure the future of the Museum and its programs for children.

An elderly lady wished to perpetuate her annual $30 gift to the Museum, so she left $30,000 to Field Museum in her will.

A retired couple, anxious to "get their affairs in order," recently drove across two states to spend a morning at the Museum to receive first-hand instructions as to how they would go about remembering Field Museum in their respective wills. A few weeks later, they wrote to say that they were leaving 25 percent of their estate to the Museum.

These are but three examples of the nearly 100 Members who, since inauguration of the Planned Giving Program two years ago this month, have notified the Museum that they are providing for the Museum in their wills. Prior to announcement of this program, many Members did

not realize that a bequest is a welcome gift to Field Museum.

All bequests, unless specifying a particular scientific department, program, or project, are placed in the Museum's General Endowment Fund, the income of which proportionally supports all the many programs of education, exhibition, and research throughout the Museum. Much of the work the Museum now does is possible because of individuals who, years ago, wished to lend a hand to the next generation and had the foresight to include the Museum in their estate plans. Before establishment of the Planned Giving Program, many Members were not aware that it has become imperative to increase the principal amount of the Endowment Fund to continue to help ensure the future of these programs.

A bequest is a thoughtful gift, because of the planning and effort involved and because it shows a Member's concern for the next generation. It demonstrates a vote of confidence in the programs of research, education, and exhibition offered by the Museum, and shows the desire to help ensure these programs for the future as the Museum moves into its second century in 1993. Such a gift can also memorialize a family name and perpetuate a Member's annual giving. Just as important is the satisfaction that one gets from knowing that his or her work will one day benefit the many—more than one million visitors a year—who come to Field Museum.

Therefore, if there are Members who have remembered Field Museum in their wills but have not notified the Museum either personally or through their attorneys, the Planned Giving Office would appreciate knowing. You may call collect (312) 322-8858, or write the Planned Giving Office.

Every person of age should have a will. A will enables a person to decide for himself or herself what will become of one's property at death, who will oversee distribution of the estate, and who will care for minor children.

Many persons think that they need not have a will because their estates are not large enough. To their surprise, they will find that their estates are larger than they every imagined, after adding up all their assets. An estate is everything that a person owns: real estate, bank account, life insurance, house, car, jewelry, antiques, stocks, bonds, mortgages, collections, and special objects of sentimental value. Nevertheless, the size of an estate is not important; without a will, the state declares where the assets of a deceased person are to be distributed, irrespective of that person's wishes.

Rainer Zangerl

Zangerl Honored

Rainer Zangerl, former chairman of the Department of Geology, now retired, was recently elected as a fellow of the American Association for the Advancement of Science. The AAAS defines a fellow as "a member whose efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished."

Zangerl's name was presented to the association council for his "contributions to paleontology, particularly for work on the prehistory of turtles and chondrichthyans and pioneering studies toward an understanding of the ecology of fossil communities."

Volunteer Ernie Reed Honored

Ernie Reed, a volunteer at Field Museum for the last three years, has been selected for the 1983 Chicago Senior Citizens Hall of Fame. The Hall of Fame honors outstanding older persons who have made significant contributions to their professions, to society, and to life in the Chicago area. Ernie and other nominees were honored at the Hall of Fame award ceremony earlier this year at the Preston Bradley Hall of the Chicago Library Cultural Center.

Ernie's background in history, education, and speech prepared him for a career in business. After serving in World War II he became manager of Education and Personnel for International Harvester. In 1949 he joined Stone Container Corporation, as vice president in charge of Industrial Relations. Upon retirement, Ernie found his part-time consulting work did not satisfy his need to remain an active part of the community, and he turned his attention and talents to Chicago's cultural institutions. Now he is active almost five days a week at Field Museum, the Art Institute, and other organizations.

Volunteering is really nothing new for Ernie. He served on the Board of the Urban League for five years and the board of Junior Achievement also for five years. For two years he served on the Mayor's Committee of the State of Illinois Chamber of Commerce. At Field Museum, Ernie uses his skill with words and his background in history to recreate the world of the Pawnee Indians for school groups who visit the Pawnee earth lodge.

Ernie personifies the kind of an active life professional people can lead after retirement. He has combined his love of a subject matter — history — and his excellent ability to communicate and interact with people in his current volunteer positions. For Field Museum, it is a bonus that he can describe his own past in Kansas

Ernie Reed

and relate it to the Pawnees, a tribe who once lived and hunted there. He is wonderful with children, and the impact of such a vigorous, enthusiastic instructor is important to many children who don't have older male role models.

Ernie's commitment also points out what volunteering can do for the senior citizen. When asked what he is proudest of in his volunteer role he replies, "That I am still able to amass information and to use it productively." For Ernie the continued opportunity to learn and to use his knowledge makes volunteering a satisfying experience.

Persons who are good with details and able to type may qualify for a behind-the-scenes volunteer job at Field Museum. Persons who like to work with people may be interested in volunteering for The Place for Wonder. An interview with the Volunteer Coordinator, Joyce Matuszewich, may be set up by calling her at 922-9410, ext. 360.

Bridge supports, dangerously weakened by flood waters, on Peru's north coast.

"El Niño": Recent Effects in Peru

Robert Feldman, visiting assistant curator of Andean archaeology, reports from Peru on the latest effects of this awesome climatological phenomenon

Photo by the author

I can't say that we predicted it, but we could see it coming. As archaeologists, we look at the past to see what happened and how the people responded, and then, generalizing from these data, try to apply our findings to the future. What we have been studying, and what has returned, is something called "El Niño," which is a perturbation of the normal climatological patterns of the tropical Pacific.

It has been said before, but I will say it again, that the coast of Peru is *normally* one of the driest deserts in the world. I must emphasize "normally," for every so often El Niño causes a change in the patterns of wind and ocean currents, a change which brings rain. It is called El Niño after a warm ocean current that invades the cold waters of Peru from the north, often around Christmas time (hence *El Niño*, Spanish for the Christ Child). The best current explanation of what causes a niño is that a period of strong trade winds blows water westward to Southeast Asia and Indonesia, resulting in a higher sea level there than in

the eastern Pacific. If the winds slacken sharply, the water—warmed by the tropical sun—sloshes back east, colliding with Peru and overriding the cold Peruvian (Humboldt) current. The warm water disrupts marine life and can cause rain to fall on the desert. The last major El Niño occurred in 1972 and, combined with overfishing, almost wiped out the vast schools of anchoveta (*Engraulis rengins*) that had propelled Peru into first place among fishing nations (with a catch greater than the combined total of both North and Central America).

The 1972 El Niño made it into the news because of its effects on fish meal production, and hence on the price of beef (cattle eat fish meal as a protein supplement) and soybeans (which had to be substituted for the missing fish meal). This niño has made the pages of the *Chicago Tribune, Sun Times,* and *Wall Street Journal* because of the effect it is having on weather in the United States. Chicago's warm winter can be attributed to El Niño's influence on ocean temperatures in the eastern Pacific off Peru, as can the rains that devastated southern California's coast, and the drought Australia is experiencing. However, the real effects of El Niño are being felt closer to the source, here in Peru, where torrential rains have isolated a quarter of the coast and a third of the highlands.

Archaeological research by Field Museum staff identified several major El Niños in the past: one, the Chimu Niño, occurred around A.D. 1100, and the other, the Moche Niño, around A.D. 400. (See July/August and September 1979 *Bulletins*). Rains caused by the Chimu Niño washed out much of the system of irrigation canals upon which the people depended for their food and water. They also scoured out the center of the valley, eroding a band up to 2 km wide to a depth of at least several meters. The resultant drop in the level of the river bed (a product of slow tectonic uplift of the coast) left the canal intakes stranded high and dry. An attempt by the Chimu to rebuild the old canals was at best only partially successful, for we see in the archaeological record that they soon abandoned the old channels and built new ones that, adjusted to the lower river intake, could not reach as much land. This process of uplift, erosion and downcutting of the river bed, and canal abandonment is a continuing one that has caused land to be lost back to the desert at an average rate of about 35 percent per 1,000 years.

The Moche and Chimu Niños were many times more destructive than the 1925 El Niño, the worst in recent history—until this year. I have just returned to Lima from Trujillo, site of our earlier studies, and can attest to the destruction the rains have caused. I was almost unable to drive the 350 miles from Lima north because rains have sent water pouring down dry washes over the highway. *Quebradas* that have not seen water in years—if not decades—were turned into raging torrents. In Chimbote (about 80 miles south of Trujillo) I did not mind paying some children 1,500 soles (about $1.20) to guide me over a 200-meter stretch of highway that had been converted into a muddy brown rushing river. (Even though I was in a four-wheel drive Toyota, it would have been of little use had I driven into a deeply eroded channel.) In several other places, the Pan American Highway had been cut but repaired. One bridge had collapsed, but fortunately in such a way that, with a few truckloads of rock and earth, was passable.

So far it has rained twice in Trujillo, first in January and again just two days (March 31) before I got there. Both times houses were damaged: flat mud roofs do not shed rain well. Mercedes, our secretary in Trujillo, was awakened in the middle of the night by water dripping on her through the bricks of her roof. Her neighbors across the street were out on their rooftop patio bailing the rainwater with buckets.

The January rain caused extensive damage to the ruins of Chan Chan, the 800-year-old capital of the Chimu empire. Chan Chan is built of sun-baked mud bricks—adobes, which are cheap, readily made, and serve well in normal times. However, they tend to melt when rained upon. The worst damage was done to the clay friezes which decorate many of the walls in Chan Chan's palaces. After the rains, puddles of mud and water were left standing in the plazas and corridors of the abandoned city.

Last week's rains indirectly flooded about two-thirds of Trujillo. The raging river spilled over into one of the main irrigation canals (La Mochica) that runs through the city. Water crested the canal's bank and soon had eroded a huge gap in the earthen walls, spilling out into the streets. Most of the water had dried up by the time I got there, but the newspaper showed photographs of people wading through the streets knee-deep in the flood. What I did see was mud everywhere, left as the waters receded. Away from the main flood, you could see little dams built from adobes or dirt by the local residents in an attempt to keep the water away from their block.

In our studies, we first noticed the past rains by the damage they did to the canals. The floods caused by the El Niño have also left their mark on the canals. The break in La Mochica will be easy to repair in comparison to the other damage. The two other main canals, the Vichansao and the Moro, share a common intake at an elaborate cement diversion and flow measuring structure—or at least they did until the Moche river washed it away, along with the first 500

meters of the channels and close to a kilometer of the main upvalley highway. I could not get in to check, but I think that the Mochica's intake was also damaged. With their intakes gone, the Vichansao and Moro filled in with sand washed down from the Andes. The sections of the channels I saw, which were once more than a meter deep and 2-3 meters wide, were brimful with sand: it will take many weeks to clean them out, but by then the crops will have dried up, for it still is a desert. Rebuilding the intakes will take a long time too—if it can be done at all. Fortunately, it does not appear that there has been much river downcutting, so new intakes can be built without too much alteration of the old canals. However, had there been downcutting, one or both of the canals might have had to have been abandoned.

Damage in Trujillo has been great, but is really nothing in comparison with what has happened farther north and in the mountains. I did not travel beyond Trujillo—indeed could not have—but the newspapers are full of reports. The departments (states) of Tumbes and Piura, in the far north of Peru, are cut off from the rest of the country. Major cities are under water, roads and bridges have been washed away, and the damage to crops and factories will run into many millions of dollars, money Peru can ill afford. Peru's oil pipeline over the Andes has been cut by landslides, but even if the crude oil could reach the refinery on the coast at Talara, it could not be processed, as flooding, mudslides, high winds, and a raging sea have destroyed parts of the refinery.

The cities of the north are isolated. The physical layout of Peru is such that there is one main coastal road: the Pan American Highway. It has been cut in a number of places, and important bridges, including a new one over the Chira River at Sullana, have either been destroyed or are in such a precarious state that they must be closed. Food and fuel are running short, as is drinking water. El Niño has also brought extremely high temperatures (more than 85°), so the heat, lack of water, and poor sanitation threaten to cause epidemics.

The city of Piura has been especially hard hit. Normally it is quite dry, a dusty little town in the middle of the desert. In his book *The Green House*, Peruvian author Mario Vargas Llosa described the nightly "rain" of fine white dust over Piura and everything in it. However (incredibly), for the last three months it has rained water on Piura every single day. Several weeks ago, a rain of 160 mm (6.3 inches) fell in one day, while just last week there was one of 75mm. With little vegetation on the desert to stop the rain, it soon builds into torrents that wash away everything in their path.

Word out of the highlands is spotty, since single roads have been blocked by landslides or the bridges have been washed away, and telephone communication is cut too. However, most of the villages of the northern third of the Peruvian Andes have been affected. Landslides have buried villages and swept buses off the highway into the rivers. With the roads cut, food and fuel are growing scarce. the Peruvian army is sending helicopters to ferry in essential supplies, but they are limited in what they can do.

Rains in the central Andes behind Lima have cut the main road from the coast to the highlands. The Central Railroad, which serves the mines of Cerro de Pasco and La Oroya, has likewise been washed away in many places. Two years ago, when I was last in Peru, limited rains caused flooding and landslides that closed the railroad for almost two months. The smelters, which depend on fuel oil brought by train, almost had to shut down. This year it looks as if it will take much more than two months to reopen the rail line, and then only when the rains stop. The break in communication means the loss of millions of dollars in mineral production.

The isolation of the north and the highlands is also affecting Lima. Produce, which travels by truck, cannot make it to the markets of Lima, which are beginning to experience spot shortages of fresh fruit and vegetables. People are beginning to complain. It remains to be seen if Peru's government—democratically elected after twelve years of military rule, can survive El Niño.

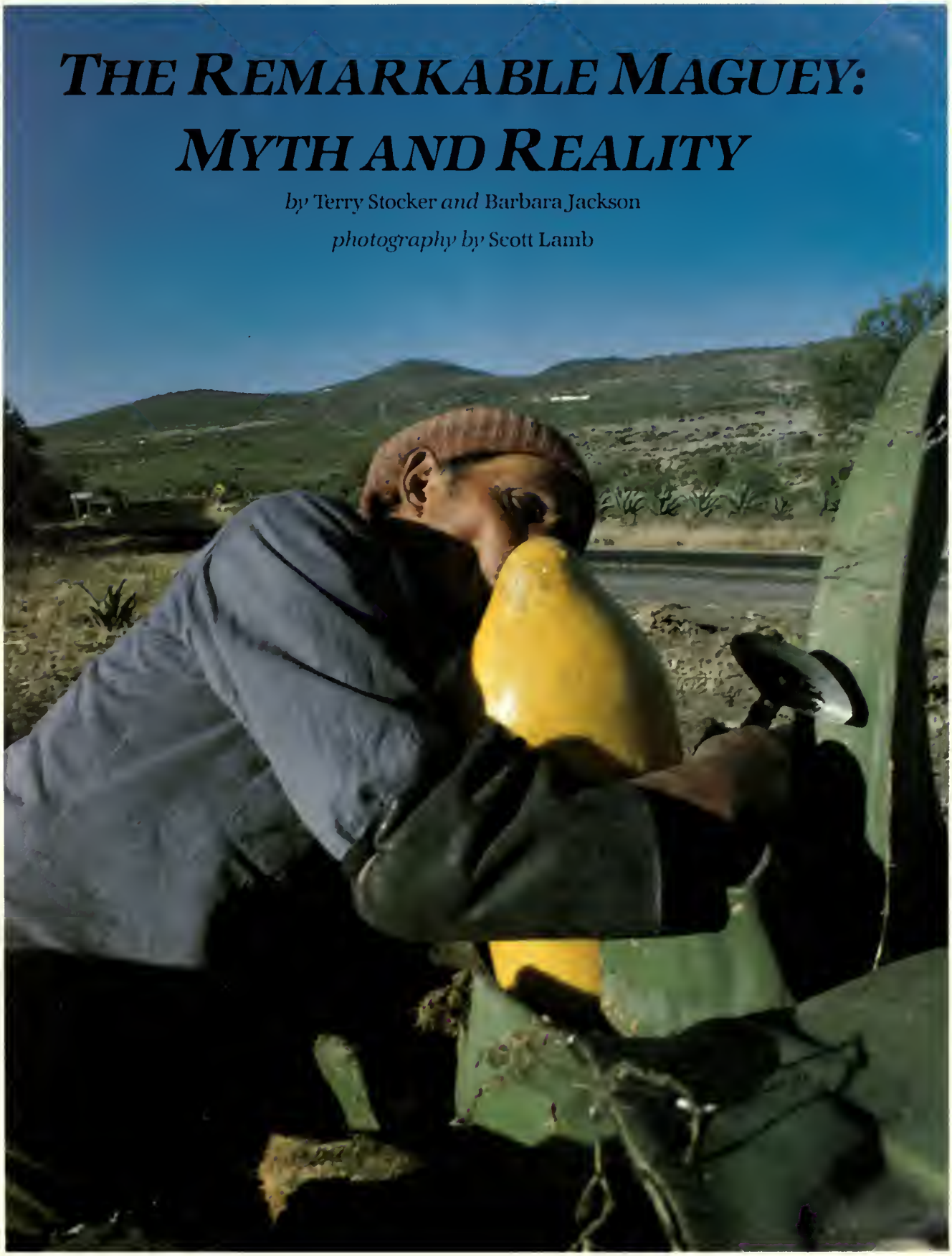
To make matters worse, and to increase the irony of the situation, the southern highlands of Peru from Cuzco through the altiplano to Lake Titicaca and beyond into Bolivia are experiencing the second year of a severe drought. January, February, and March are normally the rainy months in the sierra, but so far this year there has been only one rain. Lakes and rivers are drying up, and along with them, the fields and pasture lands. *Campesinos* (peasant farmers) are being forced to migrate to the large southern cities such as Arequipa, where there still is some water. If the drought lasts much longer—and normally there won't be much rain until the end of the year—it will create serious disruptions in the peasant economy of southern Peru and Bolivia.

The forecasts are that El Niño will continue for at least the next 6 months, if not into next year, although the present period of rains need not last as long. The lost crops and oil and mineral production will reduce Peru's 1983 gross national product by at least 10 percent, if not much more. On top of this, the government must spend millions to repair damaged roads, bridges, railroads, and cities. □

THE REMARKABLE MAGUEY: MYTH AND REALITY

by Terry Stocker *and* Barbara Jackson

photography by Scott Lamb



Tlachiquero, or Mexican aguamiel collector, siphons sap from the maguey plant. Fermented, the milky white substance becomes pulque, a popular beverage in the central Mexican plateau.

Pulque is traditionally drunk from a xoma*—half a gourd that has been gaily decorated.*

Home of the powerful Aztec and legendary Toltec civilizations, the arid plains and mountainsides of the central Mexican plateau have been occupied by man for at least ten thousand years. A vital key to human existence through the millennia here is the maguey plant, a persisting element in the dramatic mosaic of the Mexican landscape. A storehouse for many of man's basic needs, maguey provides those who nurture it with food and beverage, construction materials for buildings as well as household goods, fuel, and a means of cash income. Not surprisingly, it is also the source of considerable folklore, myth, and legend.

The genus of maguey is *Agave*, commonly known in English-speaking countries as the century plant—an exaggerated allusion to the many years of growth before coming into bloom. There are more than 300 species of the splayed, flat-leaved plant, all native to the Americas. Within the central plateau region of Mexico, about five *Agave* species, particularly *A. atrovirens*, are producers of *pulque*, a fermented beverage made from the maguey sap. The sap, called *aguamiel*, or, "honey water," ferments naturally. Since distillation was unknown to the pre-Columbian cultures of Mexico, pulque, which rarely exceeds 6 or 7 percent in alcohol content, was the only liquid intoxicant known to them. The beverage is of a thin milky-white color and, when fresh, is topped with foam much like that on a glass of milk or beer. It is rather sweet, with a distinctive flavor that turns increasingly bitter until within a week's time it is unpalatable.

Pulque

Maguey is a central focus in the lives of the Otomi Indians—the so-called "People of the Maguey," a name appropriate in history as well as the present—who live in the northern region of the state of Hidalgo, north of Mexico City. It was from the Otomi that we learned of the techniques of pulque production as well as the value of the maguey for human subsistence in the harsh central Mexican desert.

While the maguey grows wild, most of the plants observed in the Mexican landscape are cultivated. The sprouts, or *mecuates*, which appear at the base of the parent plant, are transplanted after about three years. The maguey signals its maturity with a tapering of its heart; the plant is now preparing to shoot up a flower stalk that may reach forty feet in height. If the plant is to be used for pulque production, the heart must be cut out just before maturation. The resultant scar is left to heal for a few months, then reopened and irritated to loosen the surrounding pulp, producing a cavity that serves as a reservoir for the sap secreted into it. The walls of the cavity, which is some 12 to 18 inches

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Barbara Jackson and Terry Stocker are doctoral candidates in anthropology.

across, are scraped daily to promote seepage of the aguamiel; twice daily the aguamiel is collected. For a period of six months a typical maguey may produce two to six liters of the substance daily. The leaves then wither and the plant dies.

Collection of the aguamiel is a simple siphoning procedure. Traditionally, a long, bulbous gourd has served as the *acocote*, or siphon, but today the acocote is commonly of plastic, though mimicking the natural gourd in shape and color. The siphoned aguamiel is poured into wooden and aluminum kegs carried on a donkey's back or on a cart, then taken to a collection center or the home of the collector, depending upon the size of the operation.

Pulque is produced by families for their private use as well as on a large-scale commercial basis. We had the opportunity to observe the various production stages of a large-scale pulque operation in the mountain town of Nopalillo, near Pachuca, Hidalgo. Early one morning we watched the arrival of several *tlachiqueros*, or aguamiel collectors, at the Nopalillo fermentation center; their donkeys carried kegs filled with the morning's collection of aguamiel. Following the orders of an older woman who kept an eye on activities from the door, the tlachiqueros helped one another move the heavy 40-liter kegs into the fermentation room. The kegs were then emptied into vats that already contained pulque in various stages of fermentation. When this was finished and the fermentation room padlocked, the woman was at liberty to converse with her Gringo visitors.

"As owner of such a business," she told us, "one must be very careful to keep track of the amount of aguamiel poured into each vat and to note the exact stage of fermentation. Making pulque is a delicate art. It must be allowed to ferment only so far before we send it to the main distribution center in Pachuca or it will become too strong and bitter before it can be sold. One such batch of pulque can be disastrous to the reputation of my business, so I keep a very careful watch on each of the vats. The amount of foam and the color of the liquid beneath in the vat tell me when it is time to load the trucks."

A tlachiquero receives an average of 30 pesos (about 20¢) for a *culso* (25 liters) of aguamiel, and his overall earnings depend on the number of maguey plants he collects from. At most, a tlachiquero can obtain aguamiel from 30 to 50 plants a day. The tlachiquero, then, is among the lowest paid workers in Mexico, but the activity continues to be one of the few reliable sources of income for many peasants of the central highlands.

The local pulque producer charges the regional wholesaler a minimum of 60 pesos for a culso of pulque — double what he has paid the tlachiquero. His

Otomi woman carries over her arm a bag woven of ixtli, or maguey fiber.

Two maguey stalks, about to flower, frame the majestic, 19,000-foot Pico de Orizaba.

profit margin is not much less than 100 percent, since production and transportation costs are minimal. The regional wholesaler sells pulque to the *pulquerías*, or bars, in communities of the area. The price for a glass of pulque may range from six pesos for that of average quality to fifteen for the freshest and sweetest. Between the local wholesaler and the local distributor, the price is nearly tripled from about two and one-half pesos per liter. Yet, the final price of as little as 4¢ (U.S. equivalent) a cupful is considered reasonable.

At the pulqueria one can enjoy a few rounds of pulque, relax, and chat with friends. On Sundays and festival days, it is a lively gathering center for the men. While the wives sell wares or produce in the marketplace or do their own shopping, the men enjoy the companionship of friends in the pulqueria. Once the exclusive domain of males, the pulqueria is now losing its distinctive character as a traditional Mexican institution; today one may sometimes see there a table of women friends having a round of pulque. Another change is the gradual disappearance of the *xomas*, the traditional pulque drinking cups made from the bottoms of gourds and often elaborately decorated. These are being replaced with conventional glassware—much as the acocotes, or gourd siphons, are being replaced.

Pulque is a drink of the poor, now scorned by Mexico's burgeoning middle class. The drinking of beer, which is more expensive, is a symbolic acknowledgement of the Mexican's changing perception of himself. As a result, the traditional atmosphere of the pulqueria, once an institution for males of all social and economic classes, has deteriorated. Perhaps more significant, the decline of pulque consumption has

The Tlachiquero's burro carries two kegs containing 40 liters each of aguamiel.

Aguamiel is poured into fermentation vat.

had drastic economic effects. As recently as thirty years ago, revenue from pulque sales was still contributing to the state treasury.

At what point in history the fermenting qualities of aguamiel were discovered is not known, but a 1,600-year-old mural at the pyramid of Cholula depicts a boisterous scene of pulque-drinking revelers, clearly establishing that pulque-brewing was practised long before the arrival of the Aztecs in central Mexico.

During the final stages of Aztec history, pulque overindulgence had great negative social implications. In Tenochtitlan, the capital, pulque could be publicly consumed only on certain ritual occasions. The penalty for public intoxication was public shaving of the offender's head and razing of his home. A second offense was punishable by death. Those few to whom

The coarse ixtli, or maguey fiber, once dry, is spun into thread on a homemade spinning wheel.

Weaving ixtli into cloth.

the prohibition did not apply included women who had just given birth and the aged who, being of no further use in the economy, were permitted the pleasures of indulgence during their remaining years. Finally, men who performed heavy labor were allowed to consume pulque in public because the beverage was thought to restore strength.

Tequila

Perhaps the only maguey species that continues to gain in value is the source of tequila, *Agave tequilana*. The production of tequila, now consumed worldwide, originated in the town of that name, in eastern Jalisco state, northwest of Mexico City. In order to be labeled "tequila," the spirit is still required by law to originate there. Though now a major industry with annual sales near fifty million dollars, tequila production is not of the same magnitude in the Mexican peasant economy as that of pulque which, unlike tequila, is both produced and consumed only locally.*

Maguey as Food Source

Maguey was well recognized as a food source by some of central Mexico's earliest inhabitants. Archaeologist Richard MacNeish found remains of maguey quids, chewed-up wads of the maguey heart, in the lowest habitation levels of the Tehuacan Valley sequence dating to 10,000 years ago. Though too tough and fibrous to be eaten, the maguey heart yields a nourishing liquid that is high in Vitamin C, protein, and fructose.

Later in history the young, tender, inner leaves of the maguey were used as food. One of the earliest and most thorough chroniclers of Mexican life, Friar Bernardino Sahagún, detailed techniques of preparation of different parts of the maguey for consumption: The pulpy leaves were sometimes pounded with stone, ground on a *metate*, or grinding stone, then cooked atop a *comal*, a plate for toasting tortillas. The fluid expressed from the maguey leaves could be used as a soup base. Today, the flower from the tapering maguey stalk, sautéed in oil, is considered a delicacy.

Maguey in Medicine and Ritual

As a source of medicines the maguey also figured prominently in native life. Juice pressed from the leaves of young magueys was applied to lacerations to promote healing; the dried leaves, pulverized and mixed with pine resin, provided a soothing poultice for inflammations. Pulque was also used for healing. Mixed with herbs, roots, or hot peppers, it was prescribed for a variety of ailments. Chest pains and breathing difficulties were treated with a potion of pulque brewed with peppers. Women suffering difficult childbirth were given a pulque concoction to induce labor and alleviate the pain. Even today a brew made from maguey root is commonly believed to have curative properties. Nopa-

**Nearly 7 million gallons of 110 proof tequila were exported from Mexico to the United States, alone, in 1982, a quantity which translates to about 9.5 million gallons as water is added to reduce the alcohol level to 80 proof.*

lillo's most prominent citizen assured us that this brew was the best medicine in treating tuberculosis.

Aztec priests used the sharp spines that tip the maguey leaf in rituals, inserting them into their tongues and the fleshy parts of their ears and calves; the blood was an offering to the gods.

The spines themselves were sometimes served as offerings. Friar Sahagún describes the offering of bloodied maguey spines upon a bed of cut green reeds or fir branches. Such offerings were made during designated events, perhaps festivals honoring the arrival of a new month and the god or goddess of that month. As with all other aspects of pre-Columbian ritual life, precise rules governed the method of collection, dispersal, and ultimate disposition of the spines.

Maguey Fiber

In everyday life, the sharp spines were used as needles for sewing cloth made from maguey fiber, or *ixtli*. Before the arrival of the Spaniards, most of the populace wore clothing of this fiber, cotton being reserved for the gowns and breechcloths of the elite and warrior classes. Today, however, it is rare to see clothing made from the coarse ixtli strands and sewn with a maguey needle. But Otomi in the region of Ixmiquilpan, Hidalgo, continue to fabricate and sell rope, saddle pads, storage bags, and similar items.

To prepare the fiber for weaving, it is first separated from the pulp. Placed on an inclined board, the leaf is scraped with a double-handled stick inlaid with a metal edge. After a few minutes of strenuous work the thick flesh of the leaf is removed. The exposed fibers are then hung to dry for a few days. The dried strands are spun to strengthen and lengthen the fiber, and the spun fiber is woven into the material from which the various products are fashioned, these being produced on looms of various types and sizes.

Ixtli products are sold in the regional markets that occur once a week throughout the northern section of Hidalgo and adjacent areas. Because these articles are so durable and long-lasting, they are seldom purchased, and prices remain low because the raw material is inexpensively produced and labor is cheap. Consequently, ixtli fiber goods are a poor source of income; yet, they provide the only income for many Otomi families. In contrast, sisal, or sisal hemp, and henequen, from other *Agave* species, are of much greater importance as industrial fibers, though these, too, have lost ground in recent times to the synthetics.

Other Uses

The maguey also provides a variety of other products, mostly used by the grower himself or his neighbors. Scrapings from the daily rasping of the pulque-producing plants provide fodder for livestock. The leaves are used both as roofing and as fuel; freshly cut leaves are used in the traditional Mexican *barbacoa*, a deep-pit barbequing of a whole goat or sheep. □

Various products, crafted from ixtli, await buyers in village marketplace.

OUR ENVIRONMENT

Kirtland's Warbler Apparently Holding Its Own

The recently completed census of Michigan's rare (endangered) Kirtland's warbler indicates the bird is maintaining its current population levels, according to a joint announcement of the U.S. Fish and Wildlife Service and the Michigan Department of Natural Resources.

"This year, 213 singing males were counted, compared to 207 in 1982," says Larry Ryel of the Michigan DNR. "Assuming the presence of one female for every male counted, that's a total breeding population of 426 birds. Since 1971, census takers have counted an average of 206 male warblers a year, from 167 in 1974 to 242 in 1980. Current numbers, however, are well below the 432 males found in 1951 and the 502 found in 1961," says Ryel, who is in charge of Statistics and Surveys for DNR Wildlife Division.

Some 50 workers from the Michigan DNR, U.S. Forest Service and U.S. Fish and Wildlife Service, plus several volunteers, located all but one of the birds in seven counties of northern Lower Michigan. The one exception was found in the west central-Upper Peninsula. Leading counties were: Oscoda, with 79 males; Crawford, with 72; and Ogemaw, with 42. Similar searches in Ontario, Wisconsin and Minnesota failed to turn up any of the birds, Ryel says.

The Kirtland's Warbler Recovery Team, headed by former Michigan DNR wildlife biologist John Byelich of Mio, is directing an extensive range management program on state and federal jack pine lands, designed to provide continuous habitat for a goal of 1,000 pairs of the birds. The species nests only in dense young stands of jack pine, which spring up naturally, following forest fires. Management practices include commercial timber harvests, prescribed burns, and planting.

Bald Eagle Killings Revealed

Between 200 and 300 bald eagles were deliberately killed over the last three years on and near a national wildlife refuge in South Dakota to supply feathers, beaks, talons, and bones for a lucrative black market in Native American artifacts, according to a major federal undercover operation concluded recently in eight states.

The two-year investigation by special agents of the U.S. Fish and Wildlife Service is expected to result in the charging of up to 50 individuals for their involvement in the killing or sale of 19 species of federally protected birds. Eighty federal and state conservation officers began contacting subjects and executing arrest or search warrants on June 15 in Florida, California, Utah, Oklahoma, Montana, Colorado, North Dakota, and South Dakota. Large quantities of bird parts and finished craft items were seized.

The bird feathers and parts were used to manufacture "authentic" reproductions of Indian artifacts such as headdresses, rattles, jewelry, lances, hair ties, wing and peyote fans, whistles, and other ornaments. The items were then sold to collectors and hobbyists in other parts of the nation and in Europe, where interest in American Indian artifacts is strong.

Secretary of the Interior James Watt said that the investigation indicated that the "feather traffic" exists in most states. "Nationwide, it is thought to be directly responsible for the slaughter of at least 300 bald eagles every year along with other protected species. Last year's bicentennial celebration of the naming of the bald eagle as our nation's symbol brought news that the species is beginning to recover from a number of threats," Watt said. "That's why it is particularly saddening to learn of this wanton slaughter."

The killing of migratory birds and sale of their feathers and parts are prohibited under the Migratory Bird Treaty Act. Bald eagles and golden eagles are also protected under the Endangered Species Act and the Bald and Golden Eagle Protection Act.

Secretary Watt said that the focus of this investigation was to infiltrate the illegal trade in bird feathers and parts and identify the individuals who were killing and selling them. "It is shocking that so many birds continue to be killed, since there have been several other major federal crackdowns on illegal feather traffic that have received widespread news coverage in the last two years," Watt said. "Apparently some people still haven't gotten the message that we are serious about ending this business."

Service enforcement officials note that this case differs from others in the past in that never before have such large numbers of whole carcasses been offered for sale, nor have so many individuals been charged with killing migratory birds at one time. During the investigations agents were sold 24 freshly killed bald and two golden eagle carcasses along with parts from a mix of 25 bald and golden eagles and hundreds of items made from other federally protected bird species including hawks, owls, songbirds, scissor-tailed flycatchers, and anhingas.

Many of the scissor-tailed flycatchers were killed in Oklahoma, where they are the state bird and a protected species. These birds are desired because of their two long tail feathers that are used to make decorative fans. Typically between 30 and 40 of these birds must be killed to make a single fan.

The majority of the bald eagles were killed on or adjacent to the Karl E. Mundt National Wildlife Refuge in South Dakota and Nebraska that was established in 1974 as a sanctuary for wintering and migrating eagles. Most were killed with baited traps or shot at night while roosting in trees.

Under federal regulation, the Fish and Wildlife Service provides Native Americans with eagle feathers for religious uses only from a feather repository in Pocatello, Idaho. These feathers are obtained from birds that are found dead from various accidents, natural causes, and human-related sources of mortality. The feathers may not be traded, bartered, or sold. The Fish and Wildlife Service has also provided Indians with waterfowl wings and tails and other wildlife parts obtained from hunting surveys and other sources. Possession of these items by Native Americans is legal, but sale and trade are not. Indian leaders have supported prosecution of these violations and have spoken out against the exploitation of their heritage and religion.

Penalties for each offense include: One year imprisonment and/or a $5,000 fine under the Bald and Golden Eagle Protection Act; two years imprisonment and/or a $2,000 fine for felony sale under the Migratory Bird Treaty Act, and one year imprisonment and/or a $20,000 fine for violations of the Endangered Species Act. Since 1981, 113 individuals have been convicted for violation of the Bald and Golden Eagle Protection Act. The undercover operation was coordinated by the Justice Department's Division of Land and Natural Resources (Wildlife Section) with the U.S. Fish and Wildlife Service.

TOURS FOR MEMBERS

Steamboat Cruise To Starved Rock

October 12-14

$200

Help keep alive a way of life that goes back over a hundred years to when steamboats were the fastest, most comfortable means of transportation. Join us for a one-day cruise on the *Str. Julia Belle Swain*, the last steamer on the Illinois River, which we will board in Joliet at 9:00 a.m. October 12. As we float along toward our destination (Starved Rock), we'll enjoy the picturesque scenery and several riverfront towns.

We will spend two nights at the beautiful rustic Starved Rock Lodge where we will enjoy nature walks, short talks, a slide show, and good food. Friday morning, October 14, we will return to Chicago by bus, stopping en route at the birthplace of Ronald Reagan in Tampico, Reagan's boyhood home in Dixon, the John Deere Historic Site in Grand Detour, "Black Hawk" statue at Lowden State Park, and the Stillman Valley State Monument.

Our leader is John Clay Bruner, Field Museum's collection manager of vertebrate paleontology.

Tropical Marine Biology

Exploration of Isla Roatan

February 15-24

$1,450

Crystal clear water, magnificent coral reefs, and a fantastic diversity of marine life are characteristic of the coast of Roatan, the largest of the Bay Islands in the Gulf of Honduras and some 30 miles off the Central American coast. Field Museum will conduct a 10-day tour to Roatan especially for divers that will combine superlative diving, expert instruction in marine natural history, and an opportunity to observe or actively participate in the scientific collecting of fishes.

An outstanding attraction for divers is spectacular "drop-offs" whose tops extend into depths as shallow as 25 feet. Leading the tour will be two ichthyologists with more than 10 years experience in the Caribbean as teachers, divers, and researchers. Illustrated talks about marine ecosystems will be combined with field trips to observe habitat types.

Accommodations will be at the Reef House diving resort on Roatan. The all-inclusive price of $1,450 covers all travel, lodging, and meals at the Reef House, and two or three tank dives per day. An early indication of interest is suggested.

Costa Rica

January 14-27, $2,000

Visit San Jose, Cartago, Port Limon, Puerto Viego, Port of Puntarenas, Monteverde Forest Preserve and Cloud Forest, and more. This tour will give you an opportunity to explore in depth the plants and edible fruits of this country plus many opportunities for photographing.

Dr. William C. Burger, curator and chairman of Field Museum's Botany Department, has been on nine collecting trips to Costa Rica, and visited many areas of the country. In addition to his interests in flowers and floras, Dr. Burger has been an avid amateur photographer for more than 30 years. Also, Tom Economou, horticulturist and botanical plant explorer will join our group as co-leader.

Baraboo, Wisconsin

October 1-2

$125

There is no lovelier or more diverse vacationland in American than the state of Wisconsin—scenic country roads, rolling dairyland, stunning views from the palisades and immense bluffs. Best of all the location is convenient—Baraboo is just about 2½ hours from Chicago.

Come and join us for a mini-vacation to the Baraboo range, 15,000-year-old heritage of the last glacier to cover Wisconsin. The background is fascinating; you will explore the gorges, gaps, and moraines of the hills cut by erosion and the Wisconsin Glacier under the expert guidance of our eminent and amiable geologist, Dr. Edward Olsen.

The price includes transportation by deluxe motor coach round trip from Field Museum, all meals, overnight accommodations and lectures. We have budgeted the price of this tour as low as possible to make it within reach of almost anyone interested in this special tour. Therefore, operation is contingent on an enrollment of at least 25 people.

Ancient Capitals of China

October 6-28

$3,975

Beijing, Xian, Luoyang, Zehngzhou, Kaifeng, Suzhou and Shanghai. This itinerary includes the most significant sites of early Imperial China and will give you an opportunity to explore in depth the civilization which characterizes one of the earth's longest-lived societies.

Our tour of this vast and versatile land will include the time-honored treasures of Old China given an added depth by the progressive achievements of New China. This itinerary includes side trips to the Great Wall and the Ming Tombs and the famous Longmen Caves near Luoyang. Also it will include an in-depth visit to recent archeological finds at Xian.

Our lecturer, Phillip Woodruff is experienced with travel in China, having led four previous tours for Field Museum. He speaks fluent Chinese and has an excellent rapport with the Chinese guides.

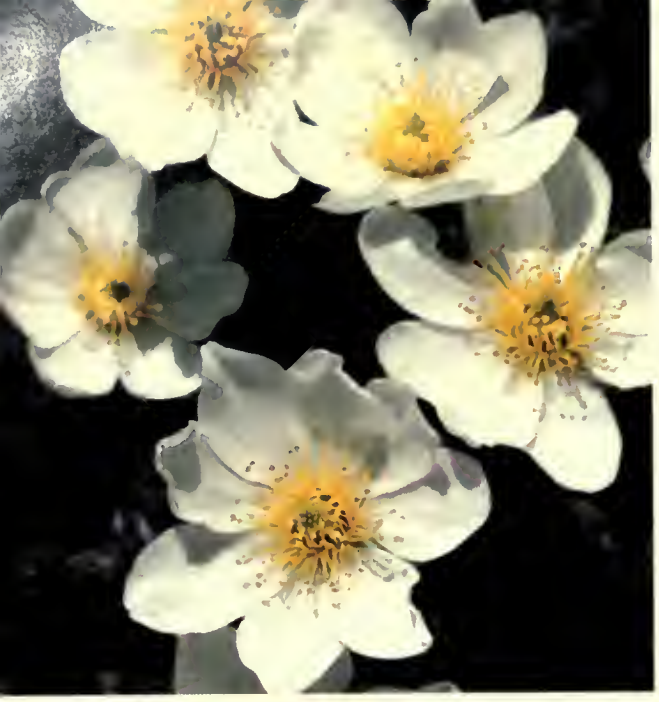
Sailing the Lesser Antilles Aboard the Tall Ship "Sea Cloud"

January 26-February 4, 1984

Our itinerary offers a superb sampling of the best of the Caribbean—Antigua, St. Barts, Saba, Martinique and Iles des Saints. With the professional leadership of Dr. John Fitzpatrick, a Field Museum scientist, you will see and experience much more than the conventional sightseer. Dr. Fitzpatrick, is an excellent tour lecturer, and your trip will be greatly enhanced by his lectures and field trips.

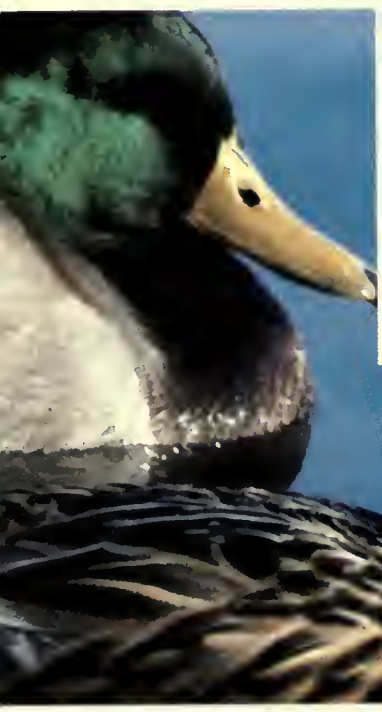
Price range, contingent on cabin selection, $3,100/$5,100 per person (includes round trip air fare from Chicago, hotel accommodations in St. John's, Antigua, full board while sailing on the *Sea Cloud).*

For additonal information on any tour, please call Tours Manager Dorothy Roder at 322-8862 or write Field Museum Tours, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.



CALENDAR 1984

Field Museum Calendar for 1984, now available, features natural history photos from Antarctica to the Canadian Rockies. 8½″ × 11″, spiralbound. Order now for immediate delivery: $4.95, postpaid (10% discount on 25 copies or more). Please make check payable to Field Museum. Send to: Calendar, Field Museum of Natural History, Roosevelt Rd. at Lake Shore Dr., Chicago, IL 60605.



FIELD MUSEUM OF NATURAL HISTORY BULLETIN

October 1983

OCTOBER EVENTS

Dinosaur Days
Oct. 22, 23

Halloween Pumpkin Carving
Oct. 29, 30

Thomas Lawton, Director, Freer Gallery of Art, Washington, D.C., lectures on "Art of the Warring States Period"
Oct. 29

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COVER

"Marsh Marigold," by Douglas Cole, Evanston, IL. Mr. Cole's photo was the grand prize winner among more than 1,000 entries in Field Musem's Plants of the World Photography Contest. For other winning entries see pages 11-18. The top 36 photos are on view in Gallery Nine through October 11.

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I certify that the statements made by me above are correct and complete. *Andrea G. Bonnette*, vice president for Finance and Museum Services.

EVENTS

Dinosaur Days

October 22 and 23
10:00am-4:00pm

Dinosaur appeal is universal. Join us for a weekend of fun and adventure. The entire family is invited to enter the realm of these fantastic creatures. Visiting scientists and Field Museum staff present slide lectures, demonstrations, and art activities to help you take a walk back in time to the world of the dinosaurs.

As a special feature of Dinosaur Days, three leading paleontologists present up-to-date theories on dinosaur behavior. Much about dinosaur behavior can be determined from clues provided by their bones and from our understanding of how living animals interact. Find out how unusual dinosaur skulls teach us about head-on combat; learn how humps, bumps, and frills functioned in the process of sexual selection, and enter the world of Pterosaurs, the flying reptiles.

Performances this year include "Galapagos," an original choreographed piece by Concert Dance, directed by Denetia Stiffler; and "Prehistoric Soundscape," created with synthesizers by Doug Babb.

Special events for families include "Dinosaurs Around the World," "Design a Dino," and "Dinosaur Egg Hunt." Learn the regions of the world where the archaeopteryx, brachiosaurus, and iguanodon lived; create your own prehistoric reptile, search the Museum for dinosaur eggs packed with prehistoric facts, view the coelacanth (a living fossil fish), and cast fossil shark teeth.

Science fiction and dinosaurs is the theme of this year's film program. Films are screened continuously. Highlights include "The Beast From 20,000 Fathoms," "Return of the Giant Monster," "Reptilicus," and more. Museum staff members are on hand to help separate fact from fiction.

Dinosaur Days promise to be exciting and information-packed for all ages. These events are free with Museum admission. To receive a copy of the complete schedule of activities, send a self-addressed, stamped envelope.

Highlights

"Harvest in the Field"
Saturday and Sunday,
Oct. 29 and 30, 1:30pm
Hall 28, Useful Plants, Second Floor

We have learned to cultivate many plants to provide us with food and other useful materials. Most plants, however, are able to manufacture their own food by the process of photosynthesis. Find out about the origins and production of some of your favorite foods like potatoes, corn, beans, and squash. Celebrate the harvest season by carving a pumpkin into your own special jack-o-lantern.

Treasures from the Shanghai Museum: 6,000 Years of Chinese Art

Opening November 5, 1983. This exhibit provides the rare opportunity to see 232 splendid objects from China. Field Museum is one of only four museums in the United States to present this collection that has never before left the Shanghai Museum. This series of lectures by foremost authorities is designed to enlighten exhibit viewers on the significance of the collection.

Art of the Warring States Period
Dr. Thomas Lawton, director,
Freer Gallery of Art, Washington, D.C.
Saturday, Oct. 29, 2:00pm

The Golden Period:
Sung Dynasty Ceramics
Dr. Yutaka Mino, curator, Department
of Oriental Art, Indianapolis Museum
of Art, Indianapolis, Indiana
Saturday, Nov. 5, 2:00pm

Legacy of the Chinese Painter
Dr. Richard Barnhart, Department
of History of Art, Yale University,
New Haven, Connecticut
Saturday, Nov. 12, 2:00pm

Members: Single Lecture: $3.00;
Series: $7.00
Nonmembers: Single Lecture: $5.00;
Series: $13.00
Please use the attached coupon to order tickets. Fees are nonrefundable.
This program is supported by the National Endowment for the Humanities, a federal agency.

Highlights

Edward E. Ayer Film Lectures

Travel the world on Thursdays in October at 1:30 pm in James Simpson Theatre. Admission free. Doors open at 12:45 pm. Members must bring their cards for priority seating privileges.

- October 6 "Canada," with Charles Forbes Taylors
- October 13 "Voyage of Columbus," with Robyn Williams
- October 20 "Japan," with Thayer Soule
- October 27 "Iceland," with Robert Davis

Weekend Programs

Each Saturday and Sunday you are invited to explore the world of natural history at Field Museum. Free tours, demonstrations, and films related to ongoing exhibits at the Museum are designed for families and adults. Check the *Weekend Passport* upon arrival for the complete schedule and program locations. These programs are partially supported by a grant from the Illinois Arts Council.

October

1 3:00pm *Treasures from the Totem Forest*
Investigate the treasures of native cultures from southeast Alaska and British Columbia, whose majestic totem poles proclaim their mystical ties to the animal and spiritual worlds.

2 1:00pm *Life in Ancient Egypt*
Experience the splendor of the pharaohs! Discover the art, beliefs, and lifestyles of the ancient Egyptians as you learn about the objects and practices which illustrate life along the ancient Nile.

8 11:30am *Ancient Egypt*
Examine the traditions of ancient Egyptian culture from everyday life to mummification and the promise of an afterlife. Find out how scholars have learned about this amazing civilization and about some of the mysteries that remain unsolved.

12:30pm *Traditional China*
Explore the fascinating culture of traditional China. Examine the timeless imagery and superb craftsmanship represented by Chinese masterworks in our permanent collection.

1:30pm *Tibet Today*
The sacred city of Lhasa, recently reopened to the world, is featured in this slide lecture about the Tibetan refugees, who have carried their faith into the mountainous areas surrounding this ancient religious center.

2:30pm *Tales from the Forbidden City*
For 500 years China was governed from a huge palace compound in the heart of the capital city of Peking. This slide lecture presents a tour of the palace city and anecdotes about Chinese imperial life during those five centuries.

9 12:30pm *Museum Safari*
See shrunken heads from the Amazon, mummies from ancient Egypt, and big game from Africa.

15 3:00pm *Battle of the Little Big Horn*
Examine the dramatic events and consequential aftermath of the famous Sioux-Custer battle. Traditional paintings by Native American artists and interpretive original photographs illustrate this informative slide lecture.

16 11:30am *China Through the Ages*
China: its inventions, Imperial court life and schools of thought are highlighted as you walk through outstanding collections covering centuries of Chinese civilization.

12:30pm *Journey Through China*
Enjoy the scenic beauty and romance of today's China in this slide lecture which carries you from modern cities of Shanghai and Suzhou to the ancient imperial capital, Xian.

2:30pm *Arts and Inventions of China*
Discover the high level of cultural and technological development of traditional China as you view magnificent art forms and ingenious inventions. Slide lecture allows close examination of significant decorative and utilitarian Chinese artifacts.

23 12:30pm *Museum Safari*
See shrunken heads from the Amazon, mummies from ancient Egypt, and big game from Africa.

29 12:30pm *Chinese Ceramic Traditions*
Exotic Chinese ceramic wares have been prized and copied for hundreds of years. Examine the styles and techniques of the Chinese ceramic tradition that is so highly valued throughout the world.

Registration

Please complete coupon for your program selection and any other special events. Complete all requested information on the application and include section number where appropriate. If your request is received less than one week before program, tickets will be held in your name at West Entrance box office until one-half hour before event. Please make checks payable to Field Museum. Tickets will be mailed on receipt of check. Refunds will be made only if program is sold out.

Program Title	Member Tickets # Requested	Nonmember Tickets # Requested	Total Tickets # Requested	Amount Enclosed
			Total	

Name

Street

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Return complete ticket application with a self-addresed stamped envelope to:

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Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605-2497

Have you enclosed your self-addressed stamped envelope?

Sea Snakes: Mark-Release-Recapture

by Harold Voris, Helen Voris, and William B. Jeffries

The bright yellow plastic tag, tiny and slim, glistened like a jewel among the gray tones of the fish and snakes in the bottom of the boat—we had recaptured our first tagged sea snake! Success of the mark-and-recapture study on sea snakes was beginning to seem possible.

We were pleased and surprised. Why surprised? Hadn't we expected it to work? Well, yes and no. As the wide mouth of the Muar River on Malaysia's southwest coast swallowed up the first batch of 55 tagged sea snakes, mostly babies at that, we looked out over the vast expanse of the Straits of Malacca, scarcely daring to hope that we would ever see any of them again. A previous researcher's attempt to do a mark-and-recapture study on the pelagic sea snake, *Pelamis platurus*, had failed to yield even one recapture after more than one thousand had been marked and released.

Having studied the venomous sea snakes at Muar over a period of more than ten years, we had several reasons to think that a mark-and-recapture study might be successful there if anywhere. Collections made in 1971, 1975, 1976, and 1981 indicated that the species composition—that is, the number and relative frequency of various species—was stable. *Enhydrina schistosa*, the beaked sea snake, which was numerically dominant, seemed like a good candidate for the study. In 1975 large collections made at Muar over a ten-month period documented the stability of the species composition throughout the year, suggesting a resident population. The age-class distribution of beaked

Harold Voris is associate curator of amphibians and reptiles, Field Museum; Helen Voris is a writer for special projects, Department of Education, Field Museum; and William B. Jeffries is a research associate, Department of Zoology, Field Museum, and Dana Professor, Biology Department, Dickinson College.

Harold and Helen Voris inspect young beaked sea snakes.

Close-up of Enhydrina schistosa, *the beaked sea snake*

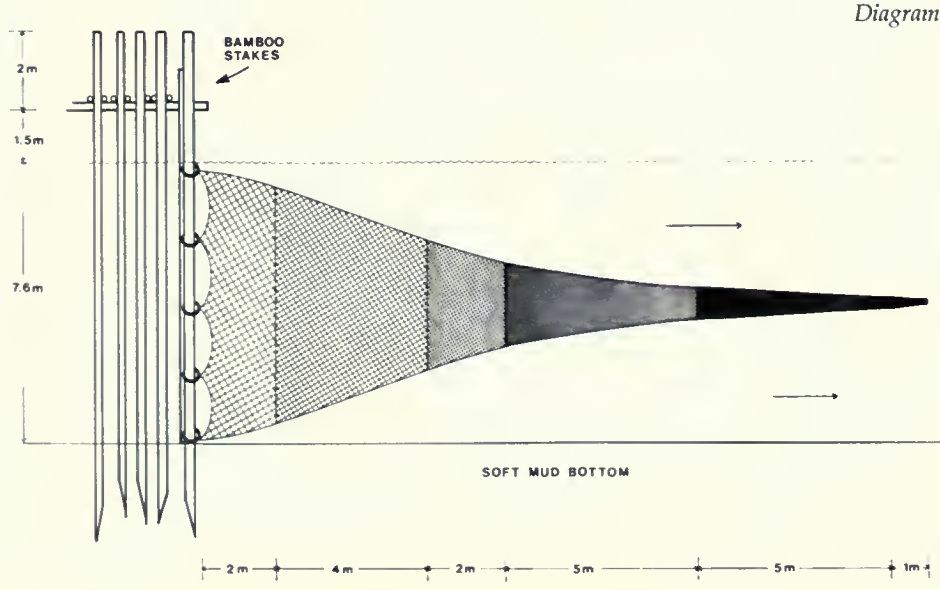
sea snakes in a subsequent collection made in 1976 differed from that of previous years in ways that suggested that the large 1975 collections had resulted in a temporary alteration in the beaked sea snake population structure; this again pointed to a resident population. Lastly, open-water trawling 50 to 100 km south of Muar rarely resulted in beaked sea snake captures, further indicating that the Muar population might be local.

Previous work on the sea snakes at Muar told us much about them. We had observed feeding behavior of the young beaked sea snakes, documented their dietary preference for catfish, and compared the diets of young and adult beaked sea snakes with other species: the beaked sea snake apparently uniquely specializes on catfish, while other species specialize on eels or even fish eggs; a few are generalists, taking everything from cuttlefish to eels. We had estimated digestion times to range from 24 to 48 hours, and average growth rates of the young to be about 2.5 cm per month. We had learned that reproduction was seasonal and, depending on the adult female's size, 6 to 32 young are born alive each year. We had been able to determine a typical population profile for the beaked sea snake; that is, how individuals are distributed into age classes.

Each step led to new questions, and the possibility of successfully marking and recapturing sea snakes held tantalizing promise of some answers which could not be obtained by analysis of collections of preserved specimens. How large is the population of beaked sea snakes? What is the rate of weight gain among the young? Is there evidence of a pattern of movement by individuals or subgroups of the population?

To estimate population size, the mark-and-recapture method requires that a sample of live animals drawn at random from the total population be marked so that their behavior and mortality are not affected when they are returned to the population. The method assumes that the marked individuals will mix randomly with the unmarked individuals and that in subsequent samples drawn from the population, neither marked or unmarked animals will be caught preferentially. The method also assumes that no

Diagrammatic side view of stake net



births, deaths, or movement in or out of the population occur over the sampling period. If all these requirements are met, then in subsequent random samples of the population the proportion of marked to unmarked snakes ought to be approximately the same as in the total population. With three out of four variables known (the total number of marked snakes, the number of marked snakes in the sample, and the total number of snakes in the sample), the fourth can then be calculated, yielding an estimate of the population size. As more samples are taken and more animals are marked, successive estimates come closer to the actual size of the population.

Unlike the estimate of population size, which requires only that marked snakes be distinguishable from unmarked ones (for example, by a notch in the tail), determination of growth and movement of individuals and the recognition of snakes from successive marking periods require that each snake have a unique identification, usually a numbered tag.

The bright yellow tag we spied in the bottom of the boat, attached to our first recaptured sea snake, was one of three tagging methods we tried. Since we didn't know which would work best (or even if any would work at all) or where to attach a tag to a sea snake, the tagging method itself required some experimentation. The thin, individually numbered tubes of yellow plastic used by marine biologists to mark fish seemed like a logical choice.

Using a special "gun," each tag was attached to the snake by a slender plastic T-shaped tether, identical to those used to attach price tags to clothing. The T was inserted just under the skin, a few centimeters from the tail on the right side of the body. This allowed the tag to stream backwards close to the body and

Tag has just been attached to sea snake's tail.

Hydrophis melanosoma, *a common sea snake resident of the Muar River estuary.*

apparently did not impede the snake's movement through the water. A short red tag was also inserted completely through the tail of the adults, using the same expanding T attachment method. A small numbered metal tag was also clipped near the tip of the tail. Adults, then, had three tags each, juveniles two. This allowed estimates of the extent to which various types of tags were lost and the application of correction factors to population size estimates.

Fortunately, our first recaptured tagged snake was not our last; subsequent sampling sessions turned up varying numbers of them. The yellow tags seemed to be the best choice: the snakes' skin healed nicely around the plastic tether, and the tags were easy to spot and to read with a minimum of handling of the snakes. The metal tags were less effective. We discontinued using them after observing that they accumulated debris and wore holes in the edges of the snake's thin paddle tails; they often fell off entirely, leaving notches.

The fate of the red tags? We still don't know—we have recaptured only 2 adult beaked sea snakes. We have marked over 600 sea snakes, including 123 adults and 397 juvenile beaked sea snakes but we have recaptured primarily juvenile beaked sea snakes. The size of the adult population remains unknown, but by treating the data on the juveniles separately, the size of this year's crop of offspring can be estimated. One estimation method uses cumulative data on recaptures in successive tidal cycles. Using data from the five tidal cycles, the population of juveniles was estimated at 1,839. But another way of analyzing the data, which is more telling and accurate, is to treat the tidal cycles independently. For the second through fourth tidal cycles studied, the size of the juvenile snake population was estimated at 1,273 (plus or minus 440), 986 (plus or

Stake net in the mouth of the Muar River, Malaysia

Young beaked sea snake eating a puff fish

minus 275), and 940 (plus or minus 288), respectively. The differences between successive estimates suggest that some mortality among the young sea snakes occurs each month. This information on mortality, unique for sea snakes and exceedingly rare even for terrestrial snakes, is extremely valuable in helping us piece together a picture of the overall dynamics of the beaked sea snake population.

Other information is also starting to accumulate from the mark-and-recapture study. As snakes were first captured they were weighed, and as they were recaptured they were reweighed, documenting a growth rate among young snakes of about one-half gram per day.

We're still wondering what's happening with the adult snakes, but we've come up with a few theories. Perhaps the most plausible is that the Muar River estuary serves as a nursery for young snakes, with the gravid females from the offshore adult population coming into the river about February each year to give birth. We think that the young may spend anywhere from 6 to 12 months in the estuary, feeding on small

catfish and some puff fish before moving further out to join the adult population, some of which occasionally feed in the estuary throughout the year. A number of questions come to mind. When does the juvenile population leave the estuary to become part of the adult pool? Are other estuaries along the southwest coast of Malaysia also nurseries for beaked sea snakes?

The Stake Net System

We may never be able to answer some of these questions, because the key to the success we have had at Muar has been the system of permanent stake nets in the mouth of the Muar River, and the extraordinary cooperation we have had over a twelve-year period from two fishermen, Chua Song Cheng (nicknamed "Ah Bee"), and Sia Meng. Sia Meng owns and operates two stake nets in the mouth of the river, and Ah Bee has two nets slightly up-river. Ah Bee's nets have been in the river about 70 years; he purchased them from the previous owner 22 years ago. Sia Meng's nets have been in his family for about 50 years. For a number of years he worked them with his father who, until recently, lived in a small house over one of the nets. In the days before motors on boats were common, this eliminated the problem of getting out to the nets twice a day during the fishing cycles.

The net system consists of two lines of bamboo poles sunk into the river bottom in a V-shaped pattern, the wide end facing up river. A conical net is attached between the two poles at the narrow end of the V. After a high tide has flowed in, the net is lowered so that as the tide recedes over about a four-to-five-hour period, the current of brackish water rushes through the net, trapping fish, prawns and sea snakes. We have measured current flow through each net at about 2.5 knots at high tide. The end of the net, which is tied closed, is checked and emptied every half hour or so into a small sampan towed by the main boat. After the tide has fully receded, the net is pulled up and laid on a platform until its next use. The tides are the strongest during the new moon and full moon periods of each lunar month and fishing is carried out for about a week during each of these two periods.

Each bamboo pole must be replaced about every three to four years at a cost of about US$40, but an occasional hardy pole can last ten years or more. Seating a new pole in the soft river mud requires the efforts of about seven or eight people. To prolong the life of the rather expensive and hard-to-replace poles, inverted tin cans are sometimes placed on them to prevent the soft centers from rotting out. (These cans also provide daytime roosts for bats, a series of which were collected for Field Museum's Mammal Division.)

Even when fishing is poor, the nets provide food for the fishermen's families through the periodic harvesting of mussels attached to the lower ends of the bamboo poles. When fishing is good, the catch can be prodigious; we watched over four bushels of fish and shrimp come in during one afternoon of fishing. Ah

Ah Bee releasing the end of the net

Ah Bee setting the net

Bee, his wife, children, relatives, and friends then spent several hours washing and sorting the catch, preparing it for market.

When the fish come in, so do the sea snakes. The reliability of the stake net system in the Muar River that has allowed us to learn so much about the sea snake community there—particularly about the beaked sea snake—offers us the chance to answer even more questions. Now that we have about 25 percent of the young beaked sea snake population marked, it may be possible to track the population over the next few years. Will the juveniles we marked this year return to the same Muar River system to breed when they have reached sexual maturity in about two years? That is, is there "homing" among sea snakes as in the salmon? Will we finally recapture more beaked sea snake adults if we return in February of next year when the gravid females usually give birth? Using the mark-and-recapture technique, we started out to learn simply the approximate size of the beaked sea snake population. The results were not exactly what we expected, but they have led us to some even more interesting research possibilities for the future. □

Harold Voris and Ah Bee bag captured sea snakes.

Plants of the World 1983 Photography Contest

In celebration of flowers and the opening of the Museum's new exhibit, "Plants of the World," 226 Chicago metropolitan photographers entered the Plants of the World 1983 photography competition. Their entries, numbering more than 1,000, were then judged by a panel of three experts: John Alderson, commercial photographer, columnist and critic, *Chicago Sun Times*; Ron Bailey, photographer, *Chicago Tribune*; and William Burger, chairman of Field Museum's Department of Botany.

This experiment in the realm of photo contests provided gratifying results. The competitors were of high calibre and addressed the subject in fascinating ways. Each photo was a reminder of the sense of discovery that happens to anyone behind a camera lens. The same sense of discovery, it is hoped, awaits those who view the 36 winning photos in a special exhibit in Gallery Nine, complementing "Plants of the World." The photo exhibit will remain on view through October 11.

The Field Museum wishes to express its appreciation to all participants in the contest for their efforts, enthusiasm, and interest in the Museum. Their helpful comments will be invaluable as the Museum lays plans for its next photo contest, scheduled for early in 1985. That event will offer photographers a broader, more inclusive range of subject categories.

Entries in this year's contest were judged for first, second, and third prizes in two categories, based on age: 16 years of age or younger (Group I), and 17 years or older (Group II). Winner of the grand prize was "Marsh Marigold," by Douglas Cole, of Evanston, IL. That photo is featured as this month's *Bulletin* cover illustration. Three other photos by Mr. Cole were also cited for excellence: an honorable mention selection, "Ostrich Fern Detail" (shown on page 16), and two recipients of certificates of selection: "Hibiscus" and "Cardinal Flower, Michigan." Photos winning the first, second, and third prizes and the six honorable mentions are reproduced on the following pages.

Certificates of selection were awarded the following:
Steve Arnam, Chicago, "Catalina Island, Kelp Forest"
Carol E. Beatty, Evanston, IL, "Cycadaceae #3"
Douglas Cole, Evanston, IL, "Hibiscus," and "Cardinal Flower, Michigan"
Marcia Dabrowski, Chicago, "Sahuaro Splendor"
Lynn Funkhouser, Chicago, "Water Lilies"
James Green, Chicago, "Untitled"
Tom Hocker, Hammond, IN, "Gloxinia #2"
James Hojnacki, Hoffman Estates, IL, "Lone Tree"
Don Josif, Naperville, IL, "Northern Ontario Fall"
A. J. Kloch, Skokie, IL, "Solitaire"
Ruth Luthringer, Oak Park, IL, "Adumbration"
Helen Lynch, Countryside, IL, "Day Lilies," "Columbine"
Ann Maksymiec, Chicago, "Pitcher Plant"
Albert J. Miller, Highland Park, IL, "Toadstools and Moss"
Michael McCafrey, Chicago, "Untitled"
Gretchen Nagel, Morris, IL, "Untitled"
Andrew Prusak, Chicago, "Alpine Larch"
Thomas J. Smith, Deerfield, IL, "Morning Mist"
James Sonju, Chicago, "Mist Rose"
Peggy Stevens, Chicago, "Yellow Fringed Orchid"
George Whittington, Downers Grove, IL, "Sugar Maple"

FIRST PRIZE, Group I
Radiant
by Kurt Jambretz
Chicago

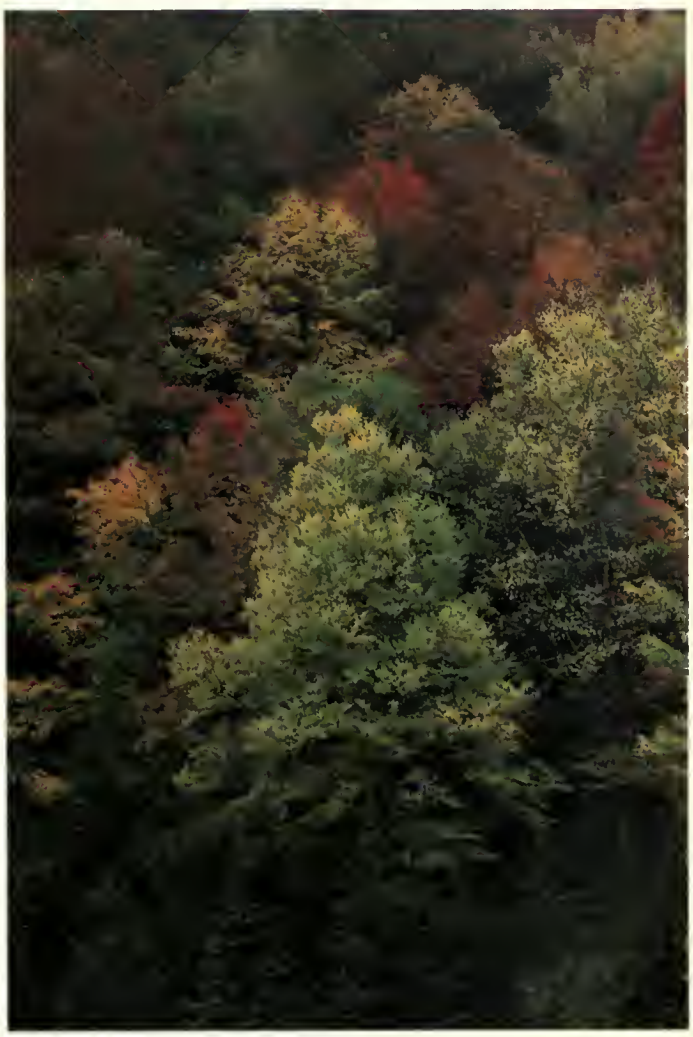
FIRST PRIZE, Group II
Cineraria
by Sandra Wojtal-Weber
Chicago

SECOND PRIZE, Group I
Balloons
by John Ellefson
Chicago

SECOND PRIZE, Group II
Orange Hawkweed
by Joan Russell
Whitefish Bay, WI

THIRD PRIZE, Group I

A House of Blossoms
by Joseph Estafanous
Country Club Hills, IL



THIRD PRIZE, Group II

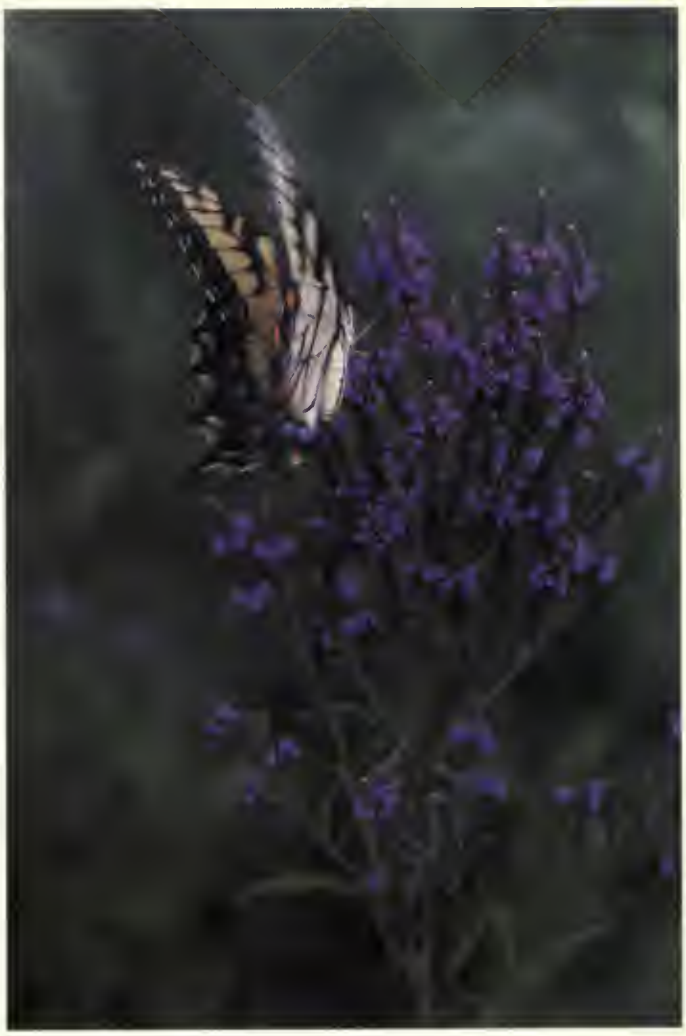
Untitled
by James Green
Chicago

Sunny Center
by Deidre Baumann
Chicago

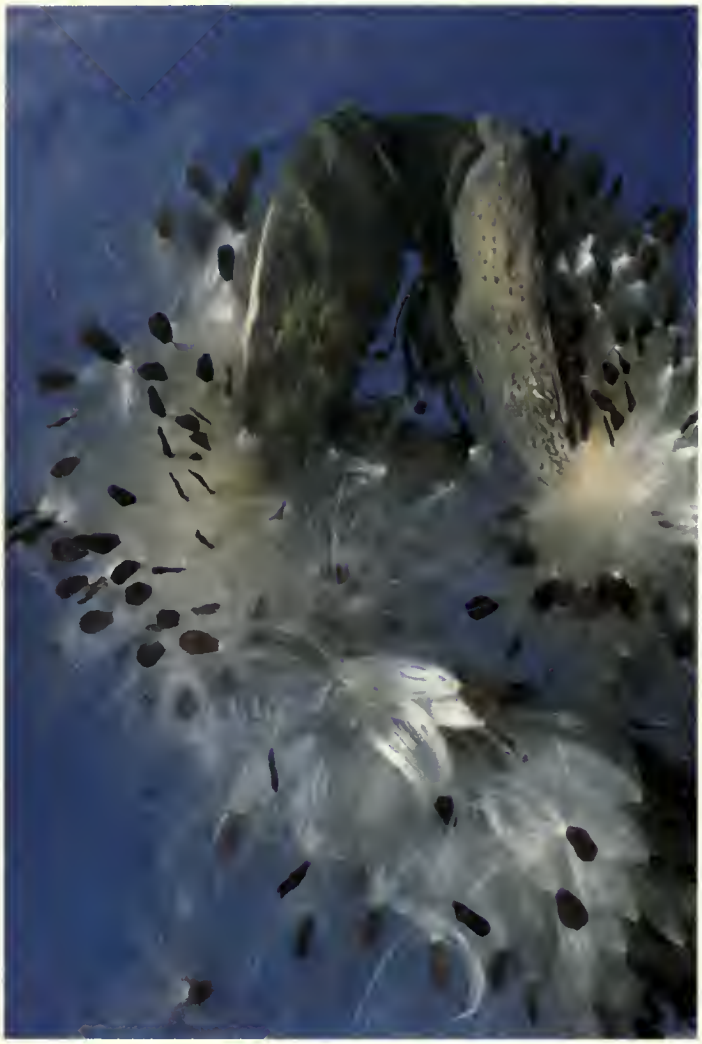
Ostrich Fern Detail
by Douglas Cole
Evanston, IL

HONORABLE MENTION

Butterfly on Flowers
by Tom Hocker
Hammond, IN



Autumn
by Thomas J. Eyerman
Oak Park, IL



Milkweed Pods
by Marguerite Hartmann
River Forest, IL

Untitled
by Mary Koga
Chicago

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The Earliest Plants on Land

by Peter R. Crane
Assistant Curator of Paleobotany
Department of Geology

Looking back on the past it is always tempting to identify certain critical events which changed the course of history and without which all that came later would have been impossible. In the history of man the first use of tools and the beginnings of agriculture were just such events, and in the history of life none was more crucial than the first colonization of the land, which had been barren since the origin of the earth itself.

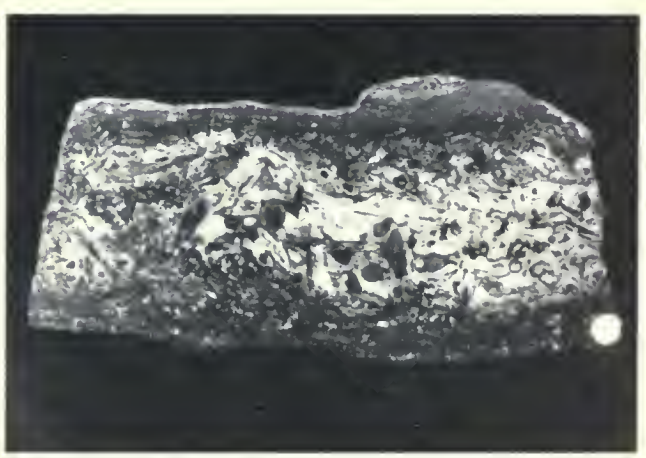
Land plants are the foundation of the terrestrial ecosystems on which we all depend for our survival. Plants harness the sun's energy to construct their tissues which provide food for the herbivores, and ultimately the carnivores, of the animal world. This simple energy economy of plant producers and animal consumers ensures that the story of the colonization of the land is first and foremost the story of the origin of land plants.

Our understanding of the earliest plants on land was built up gradually over a long period, but has increased dramatically over the last twenty years. Fragmentary and often poorly preserved fossil plants have slowly yielded their secrets to painstaking paleobotanical work, and have provided an outline of some of the major events associated with the early evolution of a land flora. Although traces of life are found in some of the most ancient sedimentary rocks on earth, dated at about 3.8 billion years before present, the first evidence of land plants is not found until approximately 430-400 million years ago. By this time a rich variety of plants and animals had already developed in the sea and presumably also in freshwater environments; and it is from forms like the green algae of today that the earliest land plants must have evolved.

It is hardly surprising that the principal difficulties which confronted plant life in making the transition from aquatic to terrestrial habitats relate directly to the problems of conserving and transporting water. Several structural innovations which appear to overcome these difficulties occur in almost all the plants living on land today. In the paleobotanical record it is the presence of these same structural innovations which allows us to infer whether a given fossil plant was more likely to have inhabited a terrestrial or an aquatic environment.

Dehydration is the most fundamental problem of life on land. To cope with this, almost all terrestrial plants have a more or less impermeable, waxy, outer covering (the cuticle), which reduces water loss and provides a barrier to mechanical damage and pathogens. However, the plant cannot be totally sealed from its environment and must retain some capability for gaseous exchange. Carbon dioxide, a vital raw material in the synthesis of complex organic molecules by photosynthesis, must be allowed into the tissues, and some mechanism must also exist to permit the escape of any excess oxygen generated by photosynthesis and not utilized in respiration.

In water plants gases are exchanged in dissolved form all over the plant body; in land plants, however, the apparently conflicting requirements of preventing water loss but at the same time allowing gaseous exchange, are reconciled by the presence of adjustable perforations (stomata) within the cuticle. Acting like a sophisticated valve, each stoma consists of a pore which can be opened or closed through the action of two flanking guard cells in response to conditions in the environment. The pore itself connects with a series of fine air spaces between the plant cells, an arrangement which allows rapid diffusion of gases throughout the plant tissues.



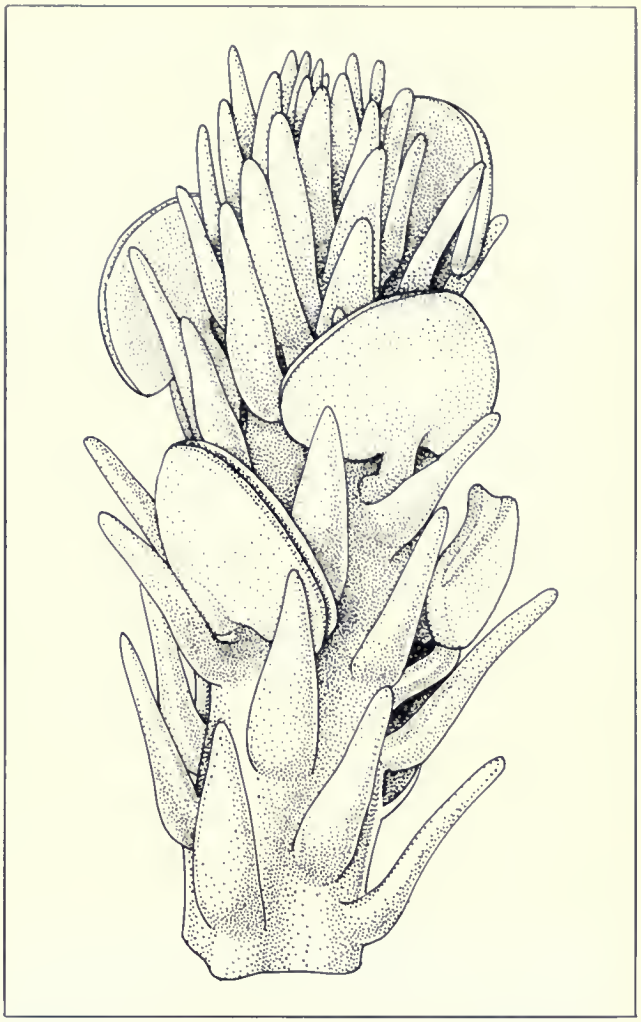
A polished slab of Rhynie chert showing a layer of peat about 4 cm thick between two layers of sand. The silicified peat contains beautifully preserved fossils of Rhynia, Asteroxylon *and other Lower Devonian plants. (Photograph by the author)*

Preventing water loss is not the only major problem for terrestrial plants; of equal importance are obtaining water and transporting it around the plant body. Aquatic plants can absorb all of their requirements from the environment over their entire surface; land plants, however, relying principally on soil moisture for water and mineral nutrients, absorb this moisture through special unicellular hairs known as rhizoids, or root hairs. The fluids are then transported around the plant body by specialized water-conducting strands, formed from numerous interconnected, elongated cells. These conducting cells, or tracheids, which are dead at functional maturity even in otherwise living tissues, are one of the most conspicuous features of most living land plants. They are generally aggregated into a vascular strand of xylem tissue in the center of the stem; this strand is surrounded by thin-walled living conducting cells known as sieve elements, which make up the phloem tissue. The main function of the xylem tracheids is to carry water and mineral nutrients absorbed from the soil, while sieve elements of the phloem carry organic nutrients generated in photosynthetic parts of the plant to all the other living tissues.

A final characteristic structural modification of land plants concerns the spores, which constitute the mobile stage in the life cycle of the simplest land plants. The spores of most aquatic plants are dispersed through water, but those of the most ancient land plants were apparently wind dispersed. During their development, spores are protected within modified spore producing capsules (sporangia). The spores themselves are protected from dehydration, physical damage, and pathogens by an extremely resistant outer wall made of a complex polyethylene-like substance, sporopollenin. The potential for aerial dispersal which this modified spore wall apparently conferred must have been an important factor in allowing rapid and effective colonization of barren land surfaces over 400 million years ago.

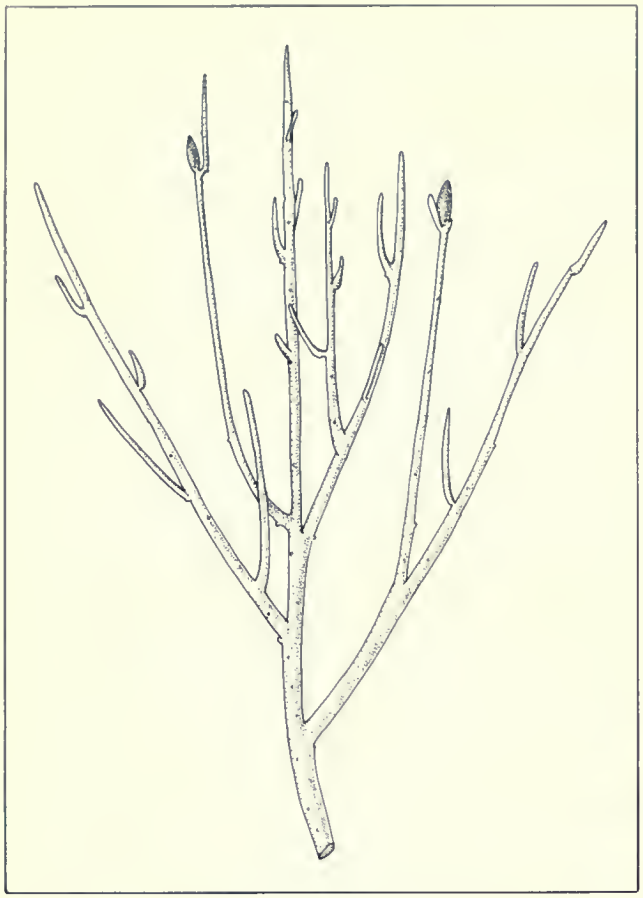
Paleobotany, like other areas of paleontology, relies for some of its most informative and spectacular fossils on a few happy accidents of preservation. For those interested in early land plants there is no more remarkable example than the early Devonian silicified peat (about 375 million years old) discovered in the early years of this century near the Scottish village of Rhynie. By a freak of serendipity the first of these plant specimens were collected from the rocks of a local wall, but later surveys and excavations revealed a small, geologically isolated deposit that is now probably one of the best known paleobotanical localities in the world.

These remarkable ancient plants were apparently preserved when the marshy area in which they were growing was flooded with groundwater rich in dissolved silica, perhaps derived from nearby hot springs. The total deposit is about eight feet thick, with alternating bands of peaty plant debris and sand. There were clearly several cycles of peat growth, each temporarily halted by a layer of sand deposited during flooding. The plants are preserved in three dimensions, embedded in hard blocks of a silica-based rock known as chert, exactly where they were growing during the early Devonian. Thin sections of the chert, reveal extremely fine microscopic details of the plant tissues.



Reconstruction of a shoot tip of Asteroxylon mackiei *from the Rhynie Chert. The stem was about 1 cm wide and covered with leaflike scales. The position and shape of the sporangia are two of the features which suggest a close relationship with present day club-mosses. Drawing based on a reconstruction in the Royal Scottish Museum, Edinburgh.*

Several kinds of plants inhabited the ancient marsh at Rhynie, but two of the best known are *Asteroxylon*, named after its xylem tissue, star-shaped in cross section, and *Rhynia*, named after the village

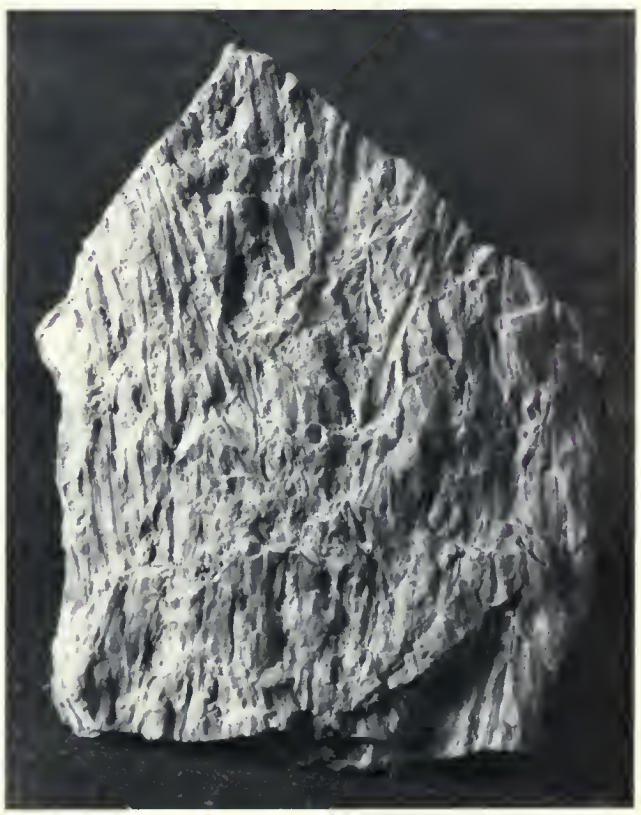


Rhynia gwynne-vaughanii *based on a recent reconstruction by Dr. David Edwards, University of Cape Coast, Ghana. The plant would probably have been about 20 cm tall, and its structure is much more complex than earlier interpretations suggested.*

which is its only known locality in the world. These two plants were both small and rather simple, but nevertheless they show some fundamental structural differences. *Asteroxylon* was entirely covered with small scales, and the spores were produced in kidney-shaped sporangia attached laterally, immediately above the leaflike scales. *Rhynia*, in contrast, had smooth naked stems with elongated, ellipsoidal sporangia borne at the stem apex. There were also important differences in the internal construction of these two plants. The xylem cylinder of *Asteroxylon* was fluted, and appears to have developed with the younger cells toward the center and the oldest cells along the flanges. In *Rhynia* the reverse seems to have been true, with the xylem developing from the inside outwards and thus the youngest cells occur toward the outside.

These two distinct suites of technical characters have been demonstrated in many other early Devonian fossils and seem to distinguish two quite different major groups of early land plants. The two lineages seem to have had separate evolutionary histories for almost 400 million years. *Asteroxylon* and certain contemporary early Devonian plants (*Zosterophyllum*, *Sawdonia*, and *Leclercqia*) seem to have been progenitors of the diminutive club mosses, or lycopods, which survive today. In fact, *Asteroxylon* bears a very striking resemblence to the most primitive living club moss, *Lycopodium selago*. *Rhynia*, on the other hand, along with its early relatives (e.g., *Psilophyton*), apparently gave rise to all other major plant groups including ferns, horsetails, seed plants, and ultimately the flowering plants themselves.

Fossil plants from Rhynie were first described over sixty years ago, and the insights which they continue to provide have been substantiated and amplified by studies of other early land plants from all over the world. Most of these other early plant fossils are much more poorly preserved; usually all that remains is a thin, compressed layer of coal. With careful preparation techniques, however, even these unpromising fossils can reveal minute details of cuticles, stomata, tracheids, and spores. It is remarkable how many of these fossils are now understood in considerable detail, and taken together they provide a fascinating picture of the early diversification of land plants. Successively younger rocks show an increasing number of more and more sophisticated types.



A mat of intertwined stems of the early Devonian plant Zosterophyllum *from the Rhine valley in Germany. Each of the stems is about 2 mm wide. Unlike the Rhynie fossils, the stems are preserved only as impressions in a hard siltstone. (Field Museum Paleobotanical Collections, PP33500)*

Lycopodium, *a living club-moss closely related to the Rhynie chert plant* Asteroxylon.

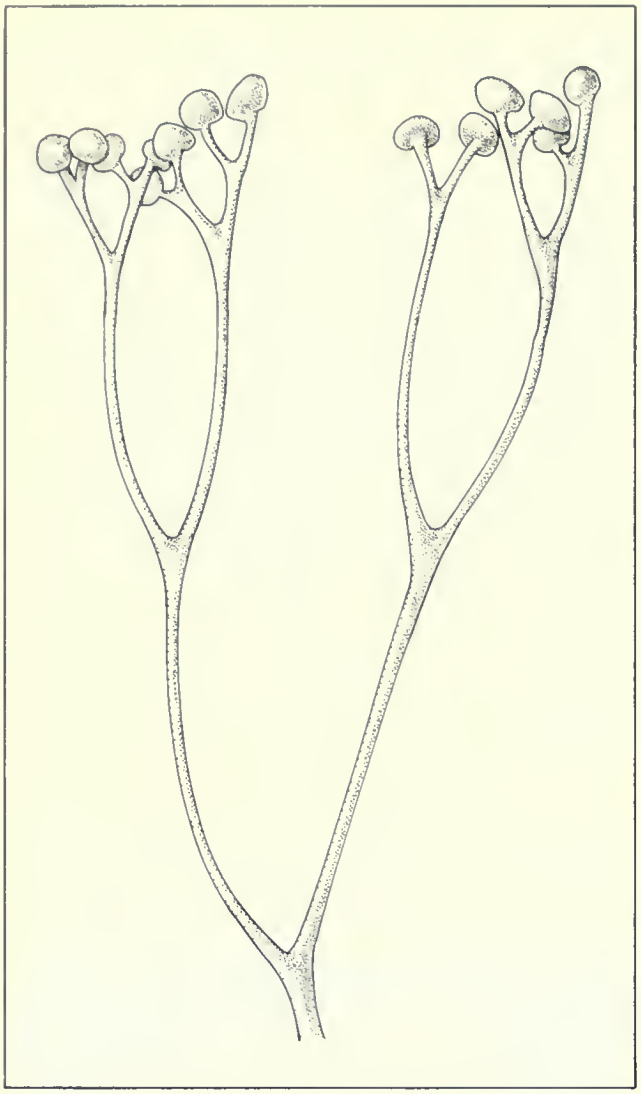
With time, there is a steady increase in plant complexity and diversity providing an unambiguous and striking testament to the concept of "descent with modification" which is at the heart of the theory of evolution. The very earliest land plants had no wood, no leaves, no seeds, and no roots, but within 50 million years all of these fundamental features of modern plant life had evolved. These spectacular developments in the plant world are paralleled in the paleozoological record, which reveals equally impressive innovations in the evolution of terrestrial animal life. Interactions between these early plants and animals were established very rapidly and represent the simple beginnings of today's complex terrestrial ecosystems.

Plants even more primitive than those found at Rhynie occur elsewhere in older rocks. The earliest of these is *Cooksonia*, first reported in mid-Silurian strata (approximately 415 million years old) in Ireland. *Cooksonia* is the name applied to tiny, simple, branching plant axes, which occasionally bear minute sporangia of about the same size as a pinhead. Ranging through about 35 million years of Silurian and Lower Devonian time, *Cooksonia* provides an instructive example of some of the many difficulties which arise as we attempt to interpret fossils of early land plants. Some of the younger *Cooksonia* specimens have yielded spores from the sporangia, but this has never been demonstrated in the older material, nor have definite tracheids or stomata been recognized in material of any age.

These apparently trivial details lead to an interesting situation: the plant fossils generally regarded as the oldest vascular land plants do not unequivocally show any of the characteristic land plant adaptations! These features are often assumed to be present by extrapolation from younger specimens, the inference being that the older material is incompletely preserved. Though this may be true, it is impossible at the moment to distinguish this situation from one in which some of the characteristic adaptations were actually absent from some of the earliest plants on land. Such absence would be of considerable biological interest, and is after all exactly what would be expected if the characteristic land plant adaptations were acquired sequentially in response to the rigors of terrestrial life. However — as is so often the case in paleontology — what can and cannot be determined from fossil material is always limited by the quality of preservation, especially if it is a feature's *absence* that needs to be established!

As we become more and more deeply embroiled in the minutiae of the fossil record it is easy to ignore or forget that the biological or evolutionary significance of even the most exquisitely preserved fossils must be interpreted within the framework that the living world

A branching spiny axis of Psilophyton *from the Rhine valley in Germany. The stem is about 2 mm wide and covered by numerous tiny spines.* Psilophyton *was a widespread early Devonian relative of* Rhynia. *(Field Museum Paleobotanical Collections, PP334990*



Cooksonia caledonica *from the Lower Devonian of Scotland, based on a reconstruction by Dianne Edwards, University College, Cardiff. Each of the terminal sporangia would have been about 3 mm in diameter.*

provides. Concerning the origin of terrestrial vegetation there are in fact several important questions derived from present-day biology on which the fossil record unfortunately remains silent. The first of these is the extent to which the first colonization of the land is analogous with the colonization of bare land surfaces on the earth by present-day plants.

Where bare land surfaces occur today they are gradually colonized, perhaps over a period of several decades, by a progressive sequence of increasingly rich and more and more diverse plant communities. This idea of vegetational succession was first developed in the early part of this century by Frederick A. Clements at the University of Minnesota. Like most abstract concepts in biology it is not totally free of difficulties and qualifications, but to Clements goes the credit for highlighting the sequential nature of vegetational change. He recognized that these changes involved progressive modification of the environment by living organisms, which was seen as moving inexorably towards some kind of apparent equilibrium, or "climax community."

The many well-known examples of succession include the growth of vegetation as a lake gradually silts up, as volcanic activity produces new rock surfaces, or as a system of dunes moves into open water. Some of Clements's most important observations were based on the sequence of changes which he observed at the Indiana Dunes, only several miles from Chicago. Many of the examples of succession which we can observe today have in their earliest stages a phase of cryptic colonization by microorganisms, including bacteria, fungi, minute arthropods, algae (particularly blue-green algae), lichens, and eventually mosses and liverworts. These organisms initiate the formation of soil which provides water and nutrients for the larger plants, or macrophytes, which appear later.

Some of these macrophytes even establish associations with soil fungi as an additional means of obtaining important nutrients. Was the advent of macroscopic land plants in the later Silurian and early Devonian preceded by a similar phase of microscopic colonization? Some paleontologists have suggested strongly that it was, and have made a distinction between two fundamental issues — the colonization of the land and the origin of vascular plants. The argument has been made that the diversification of plants in the Silurian and Devonian reflects only a radiation of vascular plants, in a sense only those plants specifi-

Polytrichum, *a true moss, and one of the more complex of living bryophytes. The importance of the bryophytes in the early colonization of the land is one of the many unsolved questions in our understanding of the development of the first terrestrial ecosystems. (Photo courtesy William Burger)*

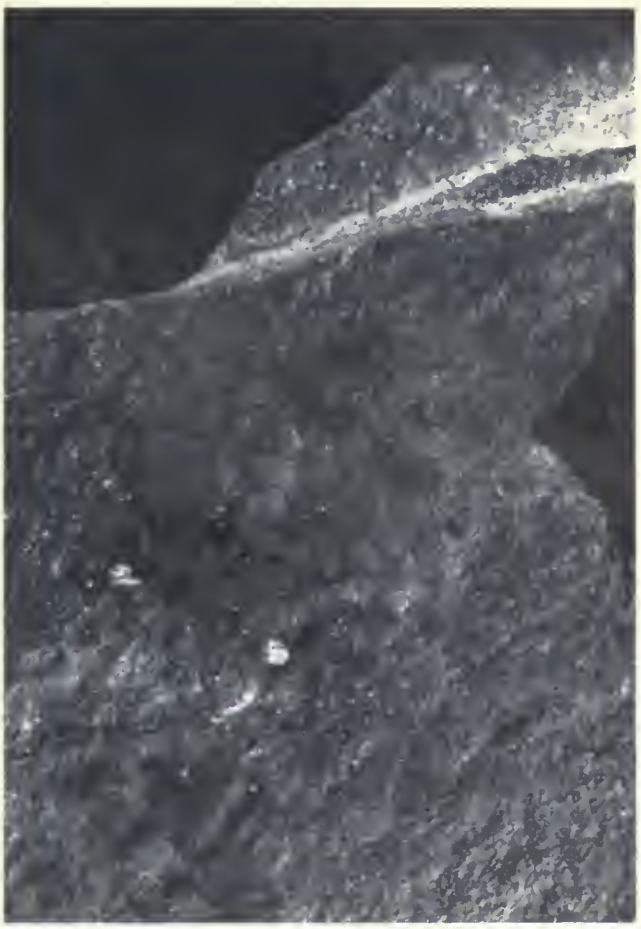
cally adapted for life on land. From the point of view of subsequent plant evolution this is of course of fundamental importance; however, excessive emphasis on the macroscopic plant record focuses on a later stage in the ecology of colonization, and perhaps diverts attention from some important ecological questions.

Not surprisingly, the fossil record contributes little to this issue of the importance of early terrestrial microorganisms, but it is of interest that in the Rhynie peat, fungi, algae, and other microorganisms are extremely abundant.

A further outstanding question, but of a different kind, concerns the relationship of mosses and liverworts (bryophytes) to more "advanced" land plants, and whether bryophytes were involved in any way in the initial colonization of the land surface. Analogies with present-day ecology imply that bryophytes, or bryophyte-like plants may have been among the earlier invaders of the land. However, although there are several enigmatic fossils which tantalizingly suggest features reminiscent of mosses and liverworts, there are no unequivocal bryophytic remains from Silurian or earliest Devonian rocks. Bryophytes fall conveniently into the category of land plants which are not "fully fledged" and do not yet possess all of the characteristic land plant adaptations. Although they produce resistant-walled spores, and occasionally have stomata, bryophytes do not possess a well developed cuticle or conducting strands of tracheids. The question of the position of the bryophytes is a fascinating and as yet unsolved issue; but when a clear understanding of early land plant evolution eventually emerges it will have to take into account the evolutionary position and ecology of this diminutive group of "incipient" land plants.

If the role of bryophytes in the early colonization of the land is enigmatic, then the position of certain bizarre Silurian and Devonian plant fossils is even more so. It is at least quite clear that the bryophytes, like the "higher" land plants, must have ultimately developed from plants similar to living green algae, with which they are linked by a wide range of morphological and biochemical features; but for most early enigmatic fossils not even their relationship to the major different kinds of algae is clear. Some of these, such as *Spongiophyton*, have thick cuticular coverings perforated by apparently simple holes on one surface, while others such as *Parka* and *Protosalvinia* produce sporopollenin-impregnated, resistant-walled spores.

There is also a rich diversity of dispersed microscopic plant debris, which includes cuticle-like sheets, resistant-walled spores, and peculiar tubes with a banded appearance which are similar but not identical to tracheids. There has been a good deal of dispute



Parka, *one of the many enigmatic early Devonian plants. Each circular area is about 2 mm in diameter and contains hundreds of resistant-walled spores. (Photograph by the author)*

between those paleobotanists who regard these remains as of uncertain relevance to the colonization of the land, and those who consider them convincing and highly significant evidence of some kind of early land flora. The basic question is whether such plants are part of the "mainstream" of land plant evolution or whether they are merely bizarre developments in quite distinct evolutionary lineages. What exactly these early plants and plant fragments are telling us is still unclear, but the evidence is mounting that they played an important ecological, if not phylogenetic, role in the colonization of the land. In the development of almost any science the most dramatic progress comes not by reiterating how good our current theories are and what they elegantly explain, but rather by worrying over the abnormal, the inconvenient, and the apparently inexplicable. In the investigation of how life moved onto land, attempts to resolve some of the many Silurian and Devonian enigmas are most likely to provide new and challenging perspectives on one of the most crucial events in the history of life on earth. □

Field Museum Stores For that Unique Gift

TOURS FOR MEMBERS

Alaska Natural History Tour

June 1984

Experience the Great Land. Descriptions of Alaska are filled with superlatives—a state more than twice the size of Texas with a population less than that of Denver, 33,000 miles of coastline, 119 million acres of forest, 14 of the highest peaks in the United States culminating in Mt. Denali (formerly Mt. McKinley), at 20,320 feet, the highest in North America. Alaska is equally a land of wildlife superlatives, from her great herds of caribou to swarming seabird rookeries to surging salmon in migration. When one thinks of Alaska one thinks of wilderness, of nature still fresh and undomesticated, of experiences dreamed of but mostly unavailable to us of the lower 48.

Join us in June 1984 for an Alaskan odyssey through a wide range of habitats from the rockbound fur seal and sea bird colonies of the Pribilofs, to the dripping forest and calving glaciers of the southeast, to the grandeur of the Alaskan Range, to the fjordlike quiet and beauty of the inland passage. Experience Alaska as few have.

Our travels will be by plane, train, bus, boat, horseback, and foot—whatever best enhances our experience. Emphasis will be on the land, its history, its wildlife. Interpretation combined with direct observation will provide an enjoyment and quality of experience unavailable to the casual visitor. Whatever your interest in natural history—marine mammals, birding, mountains, photography, flowers, forests, glaciers, icebergs, rivers—this tour will show you Alaska in all its diversity and splendor.

The tour will be led by Dr. Robert Karl Johnson, Chairman of the Department of Zoology of Field Museum.

Exact dates and rate will be announced. Please call or write to be placed on mailing list.

Costa Rica

January 14-27

$2,000

Visit San Jose, Cartago, Port Limon, Puerto Viego, Port of Puntarenas, Monteverde Forest Preserve and Cloud Forest, and more. This tour will give you an opportunity to explore in depth the plants and edible fruits of this country plus many opportunities for photographing.

Dr. William C. Burger, curator and chairman of Field Museum's Botany Department, has been on nine collecting trips to Costa Rica, and visited many areas of the country. In addition to his interests in flowers and floras, Dr. Burger has been an avid amateur photographer for more than 30 years. Tom Economou, horticulturist and botanical plant explorer will also join our group as co-leader.

Tropical Marine Biology

Exploration of Isla Roatan

February 15-24

$1,450

Crystal clear water, magnificent coral reefs, and a fantastic diversity of marine life are characteristics of the coast of Roatan, the largest of the Bay Islands in the Gulf of Honduras and some 30 miles off the Central American coast. Field Museum will conduct a 10-day tour to Roatan especially for divers that will combine superlative diving, expert instruction in marine natural history, and an opportunity to observe or actively participate in the scientific collecting of fishes.

An outstanding attraction for divers is spectacular "drop-offs" whose tops extend into depths as shallow as 25 feet. Leading the tour will be two ichthyologists with more than 10 years experience in the Caribbean as teachers, divers, and researchers: Dr. Robert Karl Johnson, curator of fishes and chairman of Field Museum's Department of Zoology; and Dr. David W. Greenfield, professor of biological sciences and associate dean of the Graduate School at Northern Illinois University. Illustrated talks about marine ecosystems will be combined with field trips to observe habitat types.

Accommodations will be at the Reef House diving resort on Roatan. The all-inclusive price of $1,450 covers all travel, lodging, and meals at the Reef House, and two or three tank dives per day. An early indication of interest is suggested.

Egypt

Wonders of the Nile

January 31-February 16, 1984

An unforgettable in-depth visit to the Land of the Pharaohs, including an 8-day Nile cruise aboard the luxurious *Sheraton Nile Steamer.* The tour leader is Dr. Bruce Williams, a distinguished U.S. Egyptologist. Dr. Williams is an expert in archaeology and ancient history, and has recently helped develop a fascinating new theory on the origins of the Egyptian state. He will travel with the tour throughout, including the Nile cruise, and personally conduct all lectures and sightseeing. Highlights of our tour will be the pyramids and Sphinx of Giza, little-visited monuments of Middle Egypt, King Tut's tomb, the holiday resort of Aswan, and a visit to Abu Simbel.

For additional information on any tour, please call Tours Manager Dorothy Roder at 322-8862 or write Field Museum Tours, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.

CALENDAR 1984

Field Museum Calendar for 1984, now available, features natural history photos from Antarctica to the Canadian Rockies. 8½″ × 11″, spiralbound. Order now for immediate delivery: $4.95, postpaid (10% discount on 25 copies or more). Please make check payable to Field Museum. Send to: Calendar, Field Museum of Natural History, Roosevelt Rd. at Lake Shore Dr., Chicago, IL 60605.

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FIELD MUSEUM OF NATURAL HISTORY BULLETIN

November 1983

TREASURES FROM THE SHANGHAI MUSEUM

6,000 YEARS OF CHINESE ART

- November 7—February 11
- Members' Preview Friday, November 4
- Chinese Art: lectures, demonstrations, films

6th Annual Anthropology Film Festival, November 19 and 20

Field Museum of Natural History Bulletin

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COVER

Tripod kui, *found in the Shanghai municipality and representative of chinese pottery of the Liangzhu culture. The piece, carbon-dated at 4,055 to 4,345 years old, is one of 232 art objects and artifacts on view in the exhibition "Treasures from the Shanghai Museum—6,000 Years of Chinese Art" from November 5 through February 14. Members' preview November 4.*

The Liangzhu culture was a stage of the regional Neolithic development that was localized along coastal areas in the northern part of Zhejiang Province and flourished during the third millennium B.C. The remarkably shaped vessel is comprised of three hollow legs that taper to tiny pointed feet. The legs join to form a lobed body with smoothly swelling contours, strongly suggestive of the form of a pig. The animal analogy is carried further in the placement of the neck at one end of the vessel above two of the legs and the tail-like wide handle at the opposite end. The mouth rim is pinched together to form a small pouring spout. Photo courtesy the Asian Art Museum of San Francisco.

CHINA

Treasures from the Shanghai Museum: 6,000 Years of Chinese Art

Lecture Series

Opening November 5. This spectacular exhibition, spanning the entire history of Chinese art, is the first U.S. showing of pieces selected entirely from the collection of a single museum in the People's Republic of China. The Shanghai Museum's collection of more than 100,000 items is one of the most comprehensive and varied in China. The 232 objects in this exhibit include bronze vessels, ceramics, paintings, applied arts, and artifacts excavated in the Shanghai region. This lecture series provides special insights into the collection's significance. The program is supported by the National Endowment for the Humanities, a federal agency.

Art of the Warring States Period
Dr. Thomas Lawton, director,
Freer Gallery of Art, Washington, D.C.
Saturday, Oct. 29, 2:00pm

The Golden Period: Song Dynasty Ceramics
Dr. Yutaka Mino, curator,
Department of Oriental Art
Indianapolis Museum of Art
Saturday, Nov. 5, 2:00pm

Legacy of the Chinese Painter
Dr. Richard Barnhart,
Department of History of Art
Yale University
Saturday, Nov. 12, 2:00pm

Members: single lecture: $3:00;
series: $7.00
Nonmembers: single lecture: $5.00;
series: $13.00
The coupon should be used to order tickets.
Fees are nonrefundable.

Highlights

Roots of Chinese Culture—Film Series
November 12, 13, and 26, 1:00pm
West Entrance

These free films explore the development of this unique civilization. The roots of Chinese culture are traced from the remnants of prehistory to modern traditions.

Saturday, Nov. 12
1:00pm
China: Portrait of the Land examines the influence of geography upon the fabric of Chinese culture.

1:30pm
Chinese Jade Carving profiles the skills and techniques of a master jade carver practicing his traditional art.

Sunday, Nov. 13
1:00pm
China: The Making of a Civilization discusses the search for the origins of Chinese civilization through artifacts, documents, and art.

1:30pm
Stilt Dancers of Long Bow Village documents the revival of stilt dancing in a rural Chinese village. Banned during the Cultural Revolution, stilt dancing is a folk art that combines myth, history, contemporary politics, and daily village life.

Saturday, Nov. 26
1:00pm
China: Hundred Schools to One documents the Warring States Period and the technological and agricultural revolution leading up to the formation of the Qin (Chin) empire (475 to 221 B.C.).

1:30pm
China: The First Empires covers the advent of the Imperial Age with Qin (Chin) and the expansion of the empire under the Han dynasty. During this period the Great Wall was built and China was centralized.

Family Feature

Painting Pandas and Chinese Animals
Monica Liu, artist and historian
Friday and Saturday, Nov. 25 and 26,
2:00pm
Stanley Field Hall

In China, the brush and ink are versatile tools used to celebrate the wonders of nature. For centuries, Chinese painters have loved to animate their works with transforming dragons, graceful cranes, menacing tigers, and playful pandas. Monica Liu demonstrates the brushwork used to depict these popular motifs. Children can try their hand at painting Chinese animals on traditional Chinese rice paper. Free activity with museum admission.

Special Events

Sixth Annual Field Museum Anthropology Film Festival

Saturday and Sunday, November 19 and 20 10:00am —5:00pm West Entrance

A special invitation to explore the rich diversity of world culture on film. The sixth annual festival features films on possession and curing, cultural ecology, art and expression, women, homes, work, and more. Filmmaker Timothy Asch introduces his new releases dealing with the life and work of a female spirit healer in Bali: *A Balinese Trance Seance, Jero on Jero,* and *A Balinese Massage.* These are shown on Saturday.

On Sunday, Timothy Asch and Napoleon Chagnon, chairman of Northwestern University's Department of Anthropology, discuss the relationship between filmmaker and anthropologist that is a requisite for the production of ethnographic documentation. *A Father Washes His Children, Children's Magical Death, The Ax Fight,* and *A Man Called Bee* were produced by Chagnon and Asch when they studied the rich and complex lives of the Yanomamo people in southern Venezuela.

Additional festival highlights include *Where Did You Get That Woman* by Loretta Smith, the memories of a ladies' room attendant; *To Find The Baruya Story,* about the work of a French anthropologist with a New Guinea tribe: and *Eze Nwata: The Small King* water rites of healing in Nigeria. New releases include *Possum Opossum, Shannon County: Home, Summer of the Loucheux,* and the shortened version of *Garlic Is as Good as Ten Mothers.*

Films are screened in James Simpson Theatre, Lecture Hall I, and Lecture Hall II, at the Museum's West Entrance. Consult the final schedule for exact times. Complete Film Notes are listed on pages 13 through 16 and are available at the festival.

Members: $6.00 Series $10.00
Nonmembers: $7.00 Series: $12.00

Students with current college I.D. are admitted at the members' price. The coupon below should be used to order series or daily tickets. Fees are nonrefundable.

Weekend Programs

Each Saturday and Sunday you are invited to explore the world of natural history at Field Museum. Free tours, demonstrations, and films related to ongoing exhibits at the Museum are designed for families and adults. Check the *Weekend Passport* upon arrival for the complete schedule and program locations. The programs are partially supported by a grant from the Illinois Arts Council.

November

5 11:30am ***Ancient Egypt.*** Investigate the traditions of ancient Egyptian civilization from everyday life to mummification and the promise of an afterlife.

6 10:00am ***Hopi Ceremonial Life.*** The Hopi Indians of northeastern Arizona established a rich and flourishing culture in their desert surroundings. Learn about the life and ceremonies of North America's oldest surviving culture.

12:30pm ***Museum Safari.*** Seek out shrunken heads from the Amazon, mummies from ancient Egypt, and big game from Africa.

20 12:30pm ***Museum Safari.*** Seek out shrunken heads from the Amazon, mummies from ancient Egypt, and big game from Africa.

26 3:00pm ***Arts and Inventions of China.*** Explore the cultural and technological achievements of classical China in a slide lecture of magnificent art forms and ingenious inventions.

27 2:30pm ***Traditional China.*** Examine the timeless imagery and superb craftsmanship represented by Chinese masterworks in Field Museum's permanent collection.

Registration

Please complete coupon for your program selection and any other special events. Complete all requested information on the application and include section number where appropriate. If your request is received less than one week before program, tickets will be held in your name at West Entrance box office until one-half hour before event. Please make checks payable to Field Museum. Tickets will be mailed on receipt of check. Refunds will be made only if program is sold out.

Program Title	Member Tickets #Requested	Nonmember Tickets #Requested	Total Tickets #Requested	Amount Enclosed
			Total:	

Name

Street

City State Zip

Telephone Daytime Evening

Have you enclosed your self-addressed stamped envelope?

For Office Use:

Date Received **Date Returned**

Return complete ticket application with a self-addresed stamped envelope to:

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Field Museum of Natural History
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NOVEMBER 5, 1983 to FEBRUARY 14, 1984

TREASURES FROM THE SHANGHAI MUSEUM

6,000 YEARS OF CHINESE ART

by Yutaka Mino *and* Katherine R. Tsiang

Photos courtesy the Asian Art Museum of San Francisco

Organized by the Asian Art Museum of San Francisco and the Shanghai Museum, the exhibition "Treasures from the Shanghai Museum: 6,000 Years of Chinese Art" comes directly from San Francisco, where it opened in May on the first stop of its U.S. tour. The Shanghai Museum holds one of the greatest collections of Chinese art in the world. Open only since 1952, it houses over 104,000 works of art in all media, dating from the Paleolithic period to the present day. The current exhibition is a spectacular selection of 232 of these works, including bronze and ceramic pieces, paintings, and examples of decorative arts

The Bronze Age in China arose from the late Neolithic culture. An emergent bronze industry produced the most impressive examples of Bronze Age craftsmanship of any early civilization in the world. In the Shang dynasty (ca. *16th-11th centuries* B.C.) *a distinctive style of ornament derived from animal forms was applied almost universally to the ceremonial bronze vessels and weapons of the nobility. A rare exception to this style is to be found in the square axe, or* yue, *above, on which the decoration consists of abstract elements only: eighteen crosses inlaid in turquoise in two rings around the central circular hole. The number and arrangement of the crosses suggests an astrological or cosmological significance. The shape of the ring of crosses resembles that of the jade annulary discs that are traditionally believed to have been symbols of Heaven.*

When the Zhou overthrew the Shang and established a new dynasty in the eleventh century B.C., they borrowed certain features of Shang civilization. Like the Shang, the Zhou made ceremonial bronze objects. Early in the dynasty, the style of these objects imitates that of their predecessors. The fangyi, *or square* yi, *above, is a wine vessel made during the reign of Emperor Yi, who ruled during the ninth century B.C. Though relatively small, the piece is monumental in design, its square form emphasized by thick, jutting flanges and the heavy knob repeating the shape of the cover. Two large curving handles resembling elephants' trunks extend upward on either side. The ornament of this piece bears elements of Shang style, such as the curvilinear bands, the clawlike hooks, and the eyes; the original animal motifs, however, have now disintegrated into abstract patterns. The only recognizable animal forms, the trunklike handles, are never seen on Shang bronzes. A 66-character inscription appearing on both the cover and the vessel records a banquet given by Emperor Yi at which he was presented gifts and he bestowed articles of jade.*

and crafts. Some of these treasures, unearthed in the Shanghai area in recent decades, bear witness to the Shanghai Museum's involvement in and sponsorship of archaeological activity in and around Shanghai.

The exhibition catalog*, prepared by the Shanghai Museum staff and translated into English, includes illustrations of every piece in the show and a brief discussion of each. Selected outstanding items in the exhibition are described here:

The study of Chinese art begins with the Neolithic period, when ceramic making began and continued to develop to a remarkably high level. The *hu,* a type of jar, shown on the previous page, is a striking example of painted Neolithic pottery. The vigorous curvilinear pattern executed in black on the red body shows skillful brushwork. The lines sweep rhythmically around the surface of the vase and converge on a number of dots and circles that appear to be the eyes and bodies of stylized birds. This *hu*, believed to have been made about 5,000 years ago, has been identified as of the Shilingxia type, a cultural phase generally associated with the Majiayao stage of the Yangshao Neolithic development in Gansu Province.

Yutaka Mino is curator of Oriental Art at the Indianapolis Museum of Art and is serving as Field Museum's visiting curator for the exhibition Treasures from the Shanghai Museum: 6,000 Years of Chinese Art. *Katherine R. Tsiang is a lecturer in Oriental art history at the Herron School of Art, Indiana University at Indianapolis.*

**On sale at the Field Museum Store. $9.95 (10% discount for Members).*

After the Zhou period, bronze objects ceased to carry their former political and ceremonial weight. With the advent of iron weapons and tools in the late Zhou, bronze was no longer regarded as the source of power and imperial authority. In later centuries, when bronze came to be used in the manufacture of Buddhist sculptures, the art of bronze casting received renewed impetus and inspiration. Introduced from China during the Han dynasty (206 B.C.–A.D. 220), Buddhism took firm hold in the Six Dynasties Period, an era of several centuries of political disunion and social instability that followed the collapse of the Han empire. Buddhism became the dominant theme of Chinese art in the Six Dynasties Period, and remained dominant in the Sui dynasty (589-618), when China was reunited. The gilt bronze altar group of the Sui dynasty shown at right is a beautiful example of Chinese sculpture on the eve of its fully mature stage. The figures are slender and natural looking, their expressions gentle and their poses graceful and relaxed. The central Buddha figure sits on a lotus pedestal, his right hand raised in the gesture of teaching. His monk's robe is worn over the left shoulder alone. The openwork halo behind his head has an outer ring of flames that encloses scrolling lotus plants among which sit seven miniature Buddha images. The two attendant bodhisattvas (beings who forego nirvana to save others) standing on either side are resplendent in elaborate crowns, long strings of jewels, and flowing scarves. In front of them are two lay persons, a man and a woman, probably donors. Two lions crouch at the front corners of the altar. The platform appears rather empty and, as evidenced by the holes pierced at either side of the Buddha, originally had more pieces attached. Comparison with the Sui bronze altar group in the Museum of Fine Arts, Boston (acc. no. 47.1407-1412) suggests that the Shanghai group, too, is likely to have been a representation of the Amitabha Buddha in his Western Paradise.

Continued on p. 20

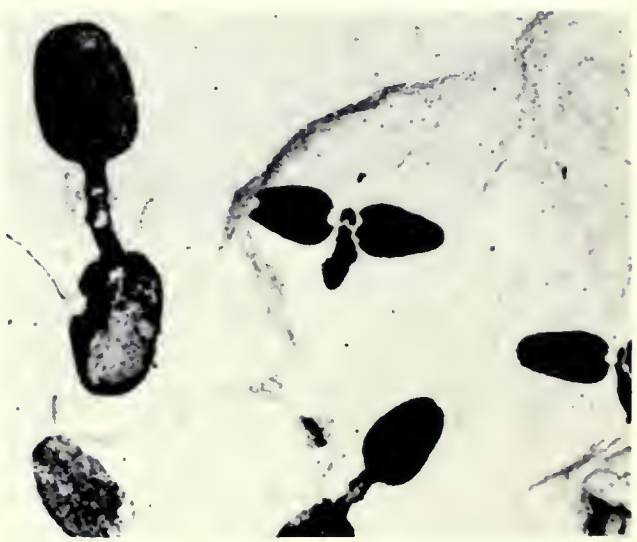
Coal ball peel through the stem of an extinct fern (Psaronius). *The small circles in a flattened ring are sections through roots which grew along the sides of the stem. Middle Pennsylvanian, West Mineral, Kansas. (Field Museum Paleobotanical Collections, PP 33614)*

The Inside Story on Fossil Plants

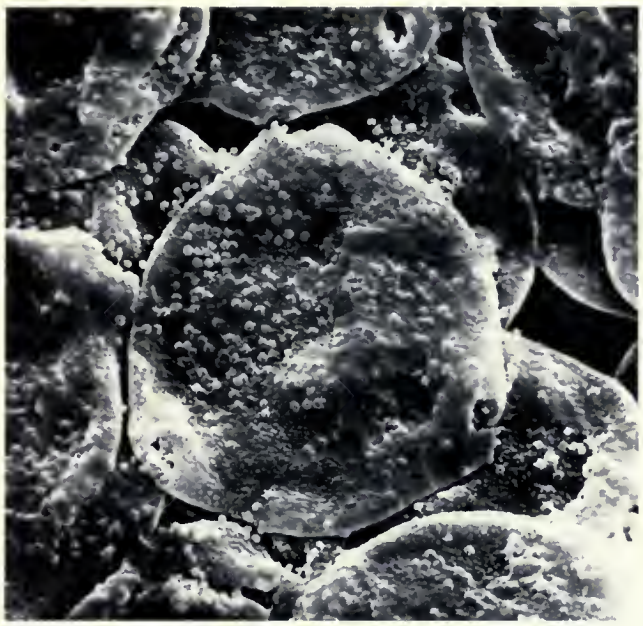
by Peter R. Crane
Assistant Curator of Paleobotany
Department of Geology

The seventeenth-century English scientist Robert Hooke is generally credited with the invention of the microscope and the first use of the term "cells" to describe the tiny compartments he observed in a thin sliver of cork. Hooke's observations were at a very cursory level, but to him goes the distinction of not only awakening an interest in the internal structures of plants and animals, but also of providing the most basic of tools by which they could be studied.

Using Hooke's microscopes, his contemporaries Marcello Malpighi and Nehemiah Grew laid the foundations of the science of plant anatomy. Three hundred years later the study of plant cells and the tissues they comprise has taken its place as an integral part of modern botanical science. The information these studies provide is crucial to understanding plant architecture and design, plant growth and development, and botanical systematics and evolution. In short, knowledge of plant anatomy is fundamental to understanding how plants work. The internal structures of plants of the past are equally important for paleobotanists in their attempts to develop a "fossil botany," and help us to understand not only how



Fossil seedlings from the Paleocene of Alberta. These seedlings were produced by an extinct plant closely related to the living katsura (Cercidiphyllum), *which grows today in Japan and central China. The specimens show pairs of seed leaves (cotyledons) about 3 mm long. The seedlings are preserved in fine mud exactly where they were growing almost 60 million years ago. (Photograph courtesy R.A. Stockey, University of Alberta.)*

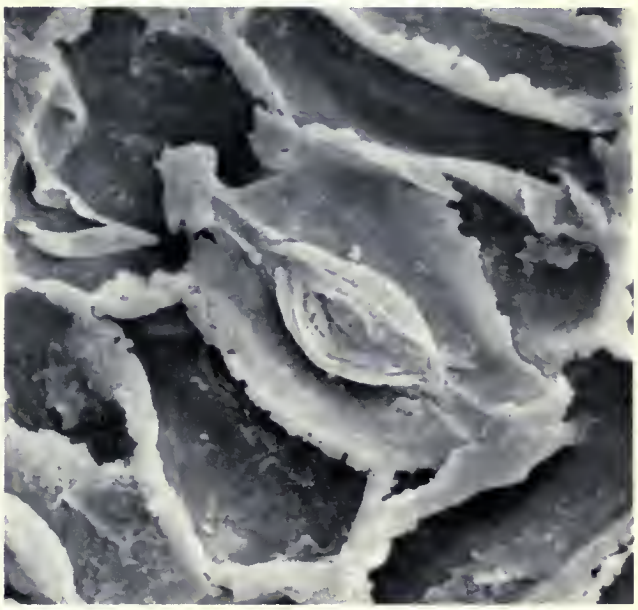


*Scanning electron micrograph of a pollen grain isolated from a Middle Eocene fossil catkin. The pollen is about 0.025 mm in diameter and is extremely similar to that of modern birch (*Betula*). Approximately 50 million years old. Princeton, British Columbia. (Photography by Ron Wibel and the author.)*

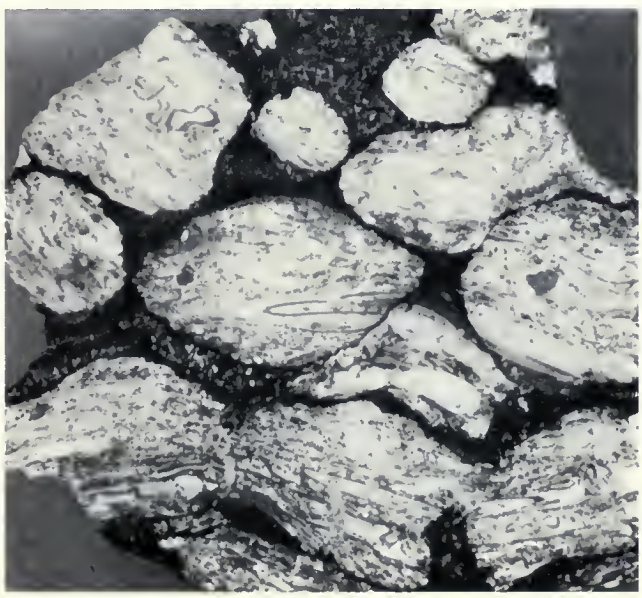
fossil plants are interrelated, but also something of the way that they functioned and grew as living organisms.

One of the common fallacies of paleontology is that plants do not generally "make good fossils." It is an idea that comes easily to those whose mental image of fossils is one of snails, clams, and trilobites, but nothing could be further from the truth. It is true that plants lack the obvious hard internal or external skeletons of many animals, but some plant parts may be extremely resistant to degradation. For example, the complex polymer which forms the outer wall of pollen and spores is one of the most indestructible and chemically inert of all biologically produced substances. Pollen and spores can be extracted from fossil flowers or cones, and the cells of leaf and stem surfaces can often be observed on fragments of the waxy plant covering, the cuticle. Fossil cuticles can be isolated from even some of the more uninspiring of plant fossils.

Under the most favorable circumstances, however, much more of the anatomy of fossil plants can be studied, particularly if the plants became embedded in minerals before they were substantially decomposed or crushed. These types of fossils are termed "petrifactions," or "permineralizations." They can faithfully preserve the plant and all its anatomical details in three dimensions. The most common minerals which preserve fossil plants are calcium carbonate, silica, and iron pyrite. Each of these minerals penetrates the plant cells in solution and subsequently precipitates due to subtle changes in chemical conditions. The detailed chemistry of the petrifaction process is complex and not fully understood, but the result is analogous to embedding parts of living plants in wax or artificial resin before preparing thin



Scanning electron micrograph of the inner surface of a cuticle isolated from a Paleocene fossil leaf (approximately 60 million years old). The specimen shows the cells around a pore (stoma) which regulated the exchange of gases between the leaf tissues and the air. (Photography by Ron Wibel and the author.)



An aggregate of coal balls encased in a matrix of coal. Middle Pennsylvanian, approximately 300 million years old. West Mineral, Kansas. (Photo courtesy R. W. Baxendale.)

Peel made from a silicified Middle Eocene peat using hydrofluoric acid to etch away the rock matrix. The specimen shows a section through a cone, and twigs of a fossil pine tree (Pinus). *The tiny triangles are sections through pine needles. Princeton, British Columbia. (Field Museum Paleobotanical Collections, PP 33258)*

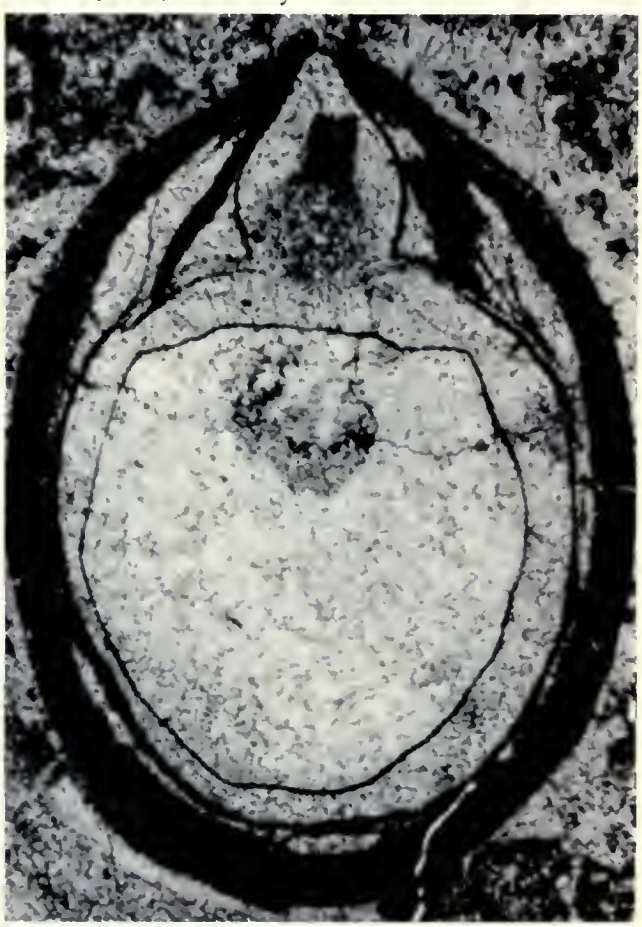
sections for microscopic examination. Thin sections of wax and resin can be cut with a sharp blade, but for fossil plants that are almost literally "turned to stone," paleobotanists have to rely on alternative but equally straightforward techniques.

Coal ball peel through the pollen producing structure (Dolerotheca) *of an extinct seed-fern. Each tiny circle is a section through a single pollen sac. Middle Pennsylvanian, Berryville, Illinois. (Field Museum Paleobotanical Collections, PP 23470)*

One of the most common types of plant fossil petrifactions is the "coal ball." This consists of masses of fragmentary plant debris embedded in a matrix of calcium carbonate. These calcareous nodules typically occur in coal seams that were deposited in an area influenced by the sea or adjacent to marine deposits; the ultimate source of the calcium carbonate is generally thought to be the shells of molluscs and other marine animals. The mineral dissolves from these shells into the groundwater and later is precipitated in and around plant debris.

Coal balls were first described from the Lancashire coal field in 1855 by two pioneers of paleobotany, Edward Binney and Joseph Hooker. In North America they were discovered much later, in 1923, when Adolph C. Noé, a faculty member at the University of Chicago and a Field Museum research associate, recognized them in some of the coals from Illinois.

The preparation technique used by Binney, Hooker, Noé, and everyone who studied coal balls



Longitudinal section through the Middle Pennsylvanian fossil seed Lagenostoma ovoides. *The specimen is about 5 mm long and was prepared from a coal ball around the turn of the century using the thin-section technique. Lancashire coal field, England. (Photo courtesy R. W. Baxendale.)*

Continued on p. 18

6TH ANNUAL ANTHROPOLOGY FILM FESTIVAL

Field Museum of Natural History

West Entrance

Saturday, November 19, 10:00am-5:00pm
Sunday, November 20, 10:00am-5:00pm

Gomis, a Ceylonese doctor. Featured in the film, The Work of Gomis.

A special invitation to explore the rich diversity of world culture on film. This year's festival consists of almost 50 films grouped by twelve subject areas: I. Papua New Guinea; II. A Woman's Place; III. We Call It Home; IV. Art and Expression; V. Uniquely U.S.; VI. Irish Peasantry—Yesterday and Today; VII. Possession and Curing; VIII. Yanomamo—The Fierce People; IX. Balinese Healing; X. Native Americans; XI. All In a Day's Work; XII. Cultural Ecology.

Filmmaker Timothy Asch introduces his new releases *A Balinese Trance Seance, Jero on Jero—A Balinese Trance Seance Observed, The Medium is the Masseuse: A Balinese Massage*, and *Jero Tapakan—Stories in the Life of a Balinese Healer*. Each film deals with the life and work of a female spirit healer in central Bali. On Sunday, Timothy Asch and Napoleon Chagnon, chairman, Department of Anthropology, Northwestern University, discuss the relationship between filmmaker and anthropologist that must occur in order to produce ethnographic documentation. *A Father Washes His Children, Children's Magical Death, The Ax Fight*, and *A Man Called Bee* were all produced by Chagnon and Asch while they were studying the rich and complex lives of the Yanomamo people in southern Venezuela.

Films are screened by subject area in James Simpson Theatre, Lecture Hall I, and Lecture Hall II. Selected films may be requested for a second screening on Sunday, in Lecture Hall II, from 1:30 to 5:00pm. The festival schedule is subject to change. The coupon on page 16 should be used to order tickets. A film schedule accompanies the tickets mailed to purchasers. Complete film notes will be available at the festival. Call (312)322-8854 for details.

10:00am-1:00pm, James Simpson Theatre

I. Papua New Guinea

Gogodala: A Cultural Revival (58m) Chris Owen, 1982, DER.
This film examines the implications of the Australian colonial era for the Gogodala people of the Fly River Delta, western Papua New Guinea.

To Find the Baruya Story: Maurice Godelier's Work with a New Guinea Tribe (58m) Allison and Mark Jablonko, 1982, Cultural and Educational Media.
Portrays the work of Maurice Godelier among the Baruya—a tribe famous for its salt-making economy.

Angels of War (54m) Andrew Pike, Hank Nelson, Gavan Daws, 1982, Filmakers Library, New York.
The horror of World War II is recalled by the peaceful people of Papua New Guinea. (Not recommended for children.)

1:30-4:30pm, James Simpson Theatre

II. A Woman's Place

Yes Ma'am (48m) Gary Goldman, 1980, Filmakers Library.
A fascinating study of sociology, southern culture, and labor and race relations portrayed by black domesties employed in the stately old houses of New Orleans.

Women in China (27m) Betty McAfee, 1978, Educational Development Center.
Betty McAfee explores a worker's villa in Shanghai where ninety percent of the women work and every type of job is available to them.

The Veiled Revolution (25m) Marilyn Gaunt, 1982, Icarus Films.
Egypt was the first Arab country where women marched to take off the veil. Today the granddaughters of these original feminists are returning to traditional Islamic dress.

Where Did You Get That Woman (28m) Loretta Smith.
An affectionate portrait of an aging washroom attendant who thrives on the social stimulation afforded by her job.

Great Grandmother (29m) Anne Wheeler and Lorna Rasmussen, New Day Films.
A story of the courageous women who settled the western plains, with reenactments of records left in diaries, archival photographs, and interviews with frontier women.

10:00am-12:00noon, Lecture Hall I

III. We Call It Home

Finnish-American Lives (47m) Michael Loukinen, 1982, Northern Michigan University.
Within the context of Finnish-American social history, this documentary explores the personal meanings of ethnicity, intergenerational relationships, and family farm life.

Shannon County: Home (A Portrait of the Ozarks) (67m) Robert Moore, 1982, Veriation Films.
The first of two films about life in a remote Ozarks county in southern Missouri.

American Chinatown (28m) Todd Carrel, 1981, UCEMC.
A story of conflicting values, a tale of tourism, commercialization, historic preservation, and the struggle of a powerless people to retain their sense of community.

12:30-3:00pm, Lecture Hall I

IV. Art and Expression

The Art of Haiti (26m) Mark Mamalakis, 1982.
Haiti, the poorest country in the Western hemisphere, was the setting for a dynamic art movement created by unschooled painters which has attracted international attention.

The Performed Word (58m) Gerald Davis, 1981, Center for Southern Folklore.
A view of black religion in a cultural context. From teens on skates to bluesmen in clubs, the film examines a wide variety of performance situations and relates them to Afro-American religious expression.

Anatomy of a Mural (15m) Rick Goldsmith, 1982.
Documents the creation and completion of a large mural painted on the face of a Latino community cultural center in San Francisco.

Cave of the Painted Hands (14m) Jorge Preloran, 1981, New Dimensions Films.
The film traces the "discovery" of the southern Argentine native cultures by Magellan to the rich, diverse cave paintings in Patagonia.

Nellie's Playhouse (14m) Linda Armstrong, 1981, Center for Southern Folklore.
She turned her house into a playhouse and her yard into a sculpture garden filled with giant purple cloth hands, huge dolls, and a host of found objects transformed into art.

3:00-4:30pm, Lecture Hall I

V. Uniquely U.S.

Garlic Is as Good as Ten Mothers (30m) Les Blank, 1983, Flower Films.
"Three nickels will get you on the subway, but garlic will get you a seat."—Yiddish slogan from New York. A thoroughly delightful film on the history, consummation, culture, curative powers, and culinary art of eating garlic.

Hush Hoggies Hush: Tom Johnson's Praying Pigs (4m) Bill Ferris and Judy Peiser, 1979, Center for Southern Folklore.
Tom Johnson of Bentonia, Mississippi, has spent 35 years training numerous litters of pigs to "pray" before they eat.

Possum Opossum (12m) Greg Kilmaster, 1981, Center for Southern Folklore.
From poetic praise to outlandish tales, the town of Clanton, Alabama has created an entirely hilarious possum mythology.

Hole in the Rock (12m) Pastor, 1982, Direct Cinema.
A visit with a unique, cavern-like tourist attraction in Utah which has served as home, restaurant, and novelty shop.

Salamander: A Night in the Phi Delt House (12m) George Hornbein and Ken Thigpen, 1982, Picture Start.
Details of an annual event at a fraternity on the Penn State campus are documented: cleaning and preparing the fraternity house, the ritual capture of live salamanders, and concluding with a very unusual contest between two coeds.

Where Oh Where Has My Little Dog Gone (14m) Daw-Ming Lee, 1982, Picture Start.
Documents the variety of relationships between animal pets and their owners.

10:00am–2:30pm, Lecture Hall II

VI. Irish Peasantry: Yesterday and Today

Man of Aran (77m) Robert Flaherty, 1934, UCEMC.
The third of Flaherty's film classics is the account of a family's struggle for survival on the Aran Islands off Ireland's west coast.

How the Myth was Made: A Story of Robert Flaherty's Man of Aran (56m) George Stoney, 1978, Films Inc.
George Stoney, descended from Aranmen, returns to the islands some 40 years after Flaherty left, to interview survivors from the cast of *Man of Aran*.

The Village (70m) Mark McCarty/Paul Hockings, 1969, UCEMC.
Human nature may be the same from China to Peru, but the life of a place is powerfully influenced by the shape of the landscape, the color of the sky, the sun and the rain, the history of the people.

A Connemara Family (55m) Hugh Brody/Melissa Llewelyn-Davies, 1983, Films Inc.
Kate Nee is a widow of nearly 80. She lives on her own small farm in the west of Ireland. She had nine children, and eight emigrated to Britain or America. This film documents her life and the changes she has seen occur in the Irish countryside.

2:30–4:00pm, Lecture Hall II

VII. Possession and Curing

Tourou et Bitti (8m) Jean Rouch, 1967, Centre National de la Recherche Scientifique.
Possession dance orchestras which accompanied traditional possession dances in the Songhay Zarma are becoming more and more rare. An interesting aspect of this film is that it was shot in a single sequence.

The Work of Gomis (48m) Yvonne Hanneman, 1972.
Gomis, a doctor in southern Ceylon, practices methods of healing thousands of years old. This film documents a 30-hour series of ceremonies in which Gomis, with dancers and artists, attempts to exorcise a man's illness.

Eze Nwata: The Little King (30m) Sabine Jell-Bahlsen, 1983.
Eze Nwata is a personal documentary of the life of a young Igbo man, about his journey to the Nigerian capital, Lagos, and his clash with the modern world, his mental breakdown, and ultimate return to a traditional life-style.

Sunday, November 20

10:00am–12:00noon, James Simpson Theatre

VIII. Yanomamo: The Fierce People

The Yanomamo Myth of Naro as Told by Kaobawa (22m) Napoleon Chagnon/Timothy Asch, 1975, DER.
Yanomamo headman Kaobawa related his version of a creation story. In the myth, jealousy and treachery among brothers leads to the creation of Hekura spirits and the origin of harmful magic.

A Father Washes His Children (13m) Napoleon Chagnon/Timothy Asch, 1974, DER.
Dedcheiwa, a shaman and headman in his village, takes nine of his children to the river where he washes them carefully and patiently.

Children's Magical Death (8m) Napoleon Chagnon/Timothy Asch, 1974, DER.
A group of Yanomamo Indian boys emulate their fathers by pretending to be shamans, blowing ashes (make-believe drugs) into one another's nostrils, dancing, chanting, and falling "unconscious" from their efforts.

The Ax Fight (30m) Napoleon Chagnon/Timothy Asch, 1975, DER.
The Ax Fight records a fight which breaks out in the village of Mishimishimabowei-teri after a conflict between a man and a woman, but is really concerned with interlineage tension.

A Man Called 'Bee': Studying the Yanomamo (40m) Napoleon Chagnon/Timothy Asch, 1974, DER.
Documents the field work as an anthropologist studies the Yanomamo tribes of Venezuela and Brazil over an 8-year period, concentrating on the growth and classification of tribes, individual members, and the layout of the villages.

12:00noon–12:45pm, James Simpson Theatre

Napoleon Chagnon, Timothy Asch discuss the relationship between anthropologist and filmmaker.

1:30–5:00 pm, James Simpson Theatre

IX. Balinese Healing

Filmmaker Timothy Asch introduces a four-part series of films about Jero Tapakan, whose personal accounts of poverty, mysticism, madness, and humility toward her calling share a commonality with accounts of many Balinese healers.

A Balinese Trance Seance (30m) Timothy Asch, 1982, DER.
Bringing offerings of rice, flowers, and woven coconut leaves, clients visit Jero in her household shrine to determine the cause of their son's death.

Jero on Jero: A Balinese Trance Seance Observed (17m) Timothy Ash, 1982, DER.
The anthropologist and filmmakers of "A Balinese Trance Seance" return to Bali with a videotaped copy of the film and record Jero's reactions to it.

The Medium is the Masseuse: A Balinese Massage (30m) Timothy Asch, 1982, DER.
Balinese spirit mediums often have specialties in addition to their abilities to contact ancestral spirits. Jero practices every third day as a masseuse.

Jero Tapakan Stories in the Life of a Balinese Healer (25m) Timothy Asch, 1982, DER.
Jero recollects her earlier poverty and despair as a farmer, and how she fled her home and wandered for years as a peddler in the countryside.

The Water of Words (30m) Timothy Asch, 1983, DER.
This film explores the poetry and ecology of the lontar (Borassus) palm on the eastern Indonesian island of Roti, a tree that provides the mainstay of the Rotinese diet.

10:00am-12:30pm, Lecture Hall I

X. Native Americans

Sun Dagger (59m) Albert Ihde, 1983, Bullfrog Films.
One of the most important early Indian discoveries in North America, "the dagger," a celestial calendar, is made by artist Anna Sofaer.

Summer of the Loucheux (28m) Linda Rasmussen, 1983, Tamarack Films.
Four generations of the Andre family of the Yukon and Northwest Territories provide vivid recollections of life at the turn of the century.

Cave of the Painted Hands (14m) Jorge Preloran, 1981, New Dimensions Films
See Art and Expression, section IV.

Corn of Life (19m) Donald Coughlin, 1983, UCEME.
Documents the traditional actions associated with corn, which is still a part of Hopi Indian family and community life.

Haudenosaunee: Way of the Longhouse (13m) Robert Stiles, 1982, Icarus.
Haudenosaunee describes the detailed and interrelated code of principles and concepts, known as the Great Law of Peace, which underlies the traditional Haudenosaunee culture and way of life.

1:00-5:00 pm, Lecture Hall I

XI. All In a Day's Work

Yes Ma'am (48m) Gary Goldman, 1982, Filmakers Library
See A Woman's Place, section II

Japan Inc: Lessons for North America (28m) Kaole Lasn, 1981, National Film Board of Canada
Organization, discipline, and production in Japan are on a scale not known in any other country in the world. How this was achieved and how it is maintained are documented in this absorbing study of Japanese government, business, and industry.

Miles of Smiles, Years of Struggle (55m) Paul Wagner, 1982, Benchmark Films
The history of the pullman porters and the growth of the black pullman porters' union as told by the porters themselves.

Coalmining Women (40m) Elizabeth Barret, 1982, Appalshop Films
Coalmining Women traces women's significant contribution to coal field struggles, and the importance of their new position as working miners.

10:00am-1:00pm, Lecture Hall II

XII. Cultural Ecology

Water of Words: Cultural Ecology of a Small Island (30m) Timothy Asch, 1983, DER.
See Balinese Healing, section IX.

The Turtle People (26m) Brian Weiss/James Ward, 1973, B & C Films.
The coastal Miskito of eastern Nicaragua were sustained for over 350 years by the green sea turtle. Today they pursue the turtle not for food but for the cash it will bring them. Soon, the drastically depleted turtle population will provide the people with neither cash nor food.

The Fragile Mountain (55m) Sandra Nichols, 1982.
The Himalayas are the highest mountains on earth; they are the lands of eternal snows, the home of the gods, the site of Shangri-la. They are crumbling away due to overpopulation and deforestation. Whatever action is taken will affect half a billion people of the wide Gangetic plain of India and Bangladesh.

To Find the Baruya Story: Maurice Godelier's Work With a New Guinea Tribe (59m) Allison and Mark Jablonko, 1982, Cultural and Educational Media.
See Papua New Guinea, section I.

1:30-5:00pm, Lecture Hall II

- Selected films will be screened a second time by special request.

Sixth Annual Festival of Anthropology on Film

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Please use West Entrance for free admission to Museum. Confirmations are mailed upon receipt of check. If coupon and check are received one week or less before the program, reservations are held in your name at the West door. Please include self-addressed, stamped envelope. Mail to:

Film Festival/Education Department
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CALENDAR 1984

Field Museum Calendar for 1984, now available, features natural history photos from Antarctica to the Canadian Rockies. 8½″ × 11″, spiralbound. Order now for immediate delivery: $4.95, postpaid (10% discount on 25 copies or more). Please make check payable to Field Museum. Send to: Calendar, Field Museum of Natural History, Roosevelt Rd. at Lake Shore Dr., Chicago, IL 60605.

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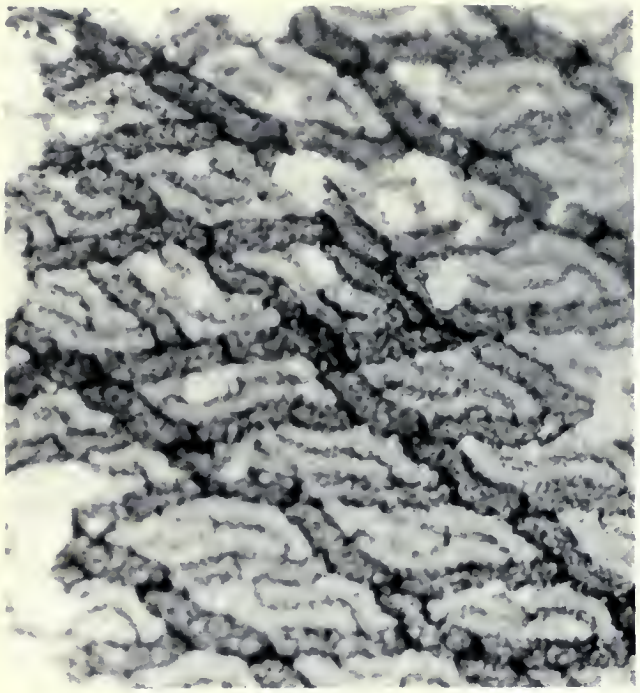
Continued from p. 12

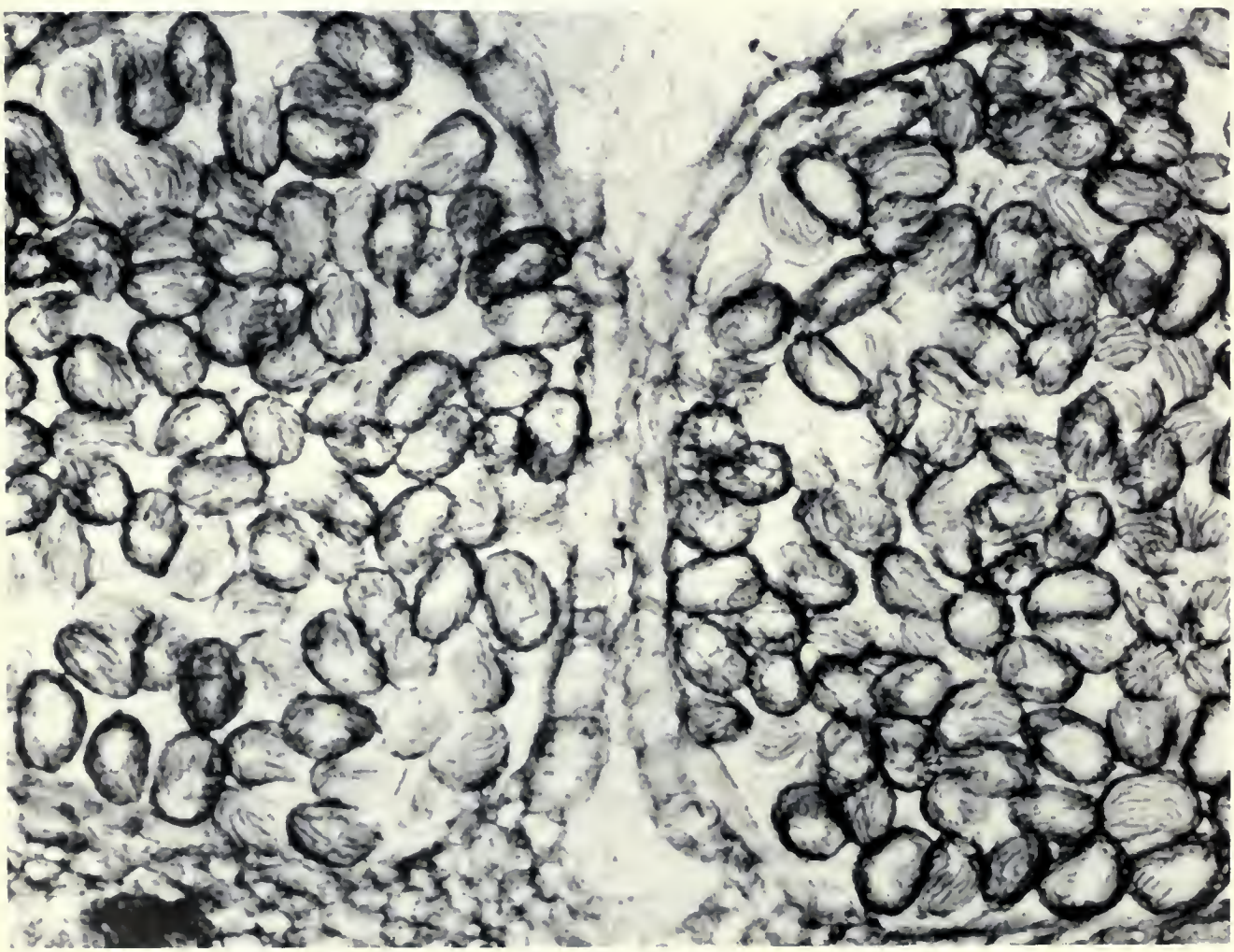


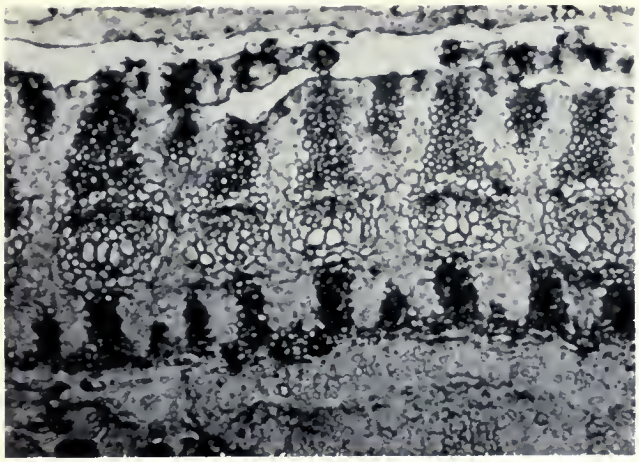
Preparation of a leaf fragment from the fossil moss Protosphagnum *showing the complex arrangement of cells. The darker cells were about 0.05 mm long and probably involved in photosynthesis. The lighter cells were probably filled with water in life. Permian, approximately 250 million years old, Kouznetsk Basin, U.S.S.R. (University College London Collection, photo by the author.)*

for nearly seventy-five years, involved preparing extremely thin rock sections. The method consisted of cutting a very thin sliver of rock, gluing this to a glass microscope slide, and then carefully grinding the section until it was sufficiently thin and transparent to be examined under the microscope. It was an extremely laborious technique that required considerable skill, but it produced extremely fine results.

The information from such preparations dramatically increased our knowledge of coal forest plants,

Coal ball peel through two sporangia of a Middle Pennsylvanian fern, showing the sporangium wall and spores inside. Each spore is about 0.03 mm long. Middle Pennsylvanian, Mahaska County, Iowa. (Photo courtesy R. W. Baxendale.)





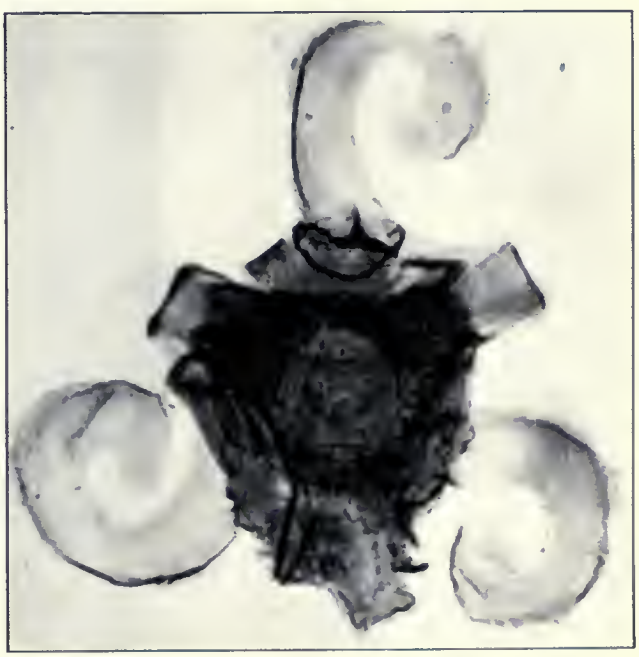
Coal ball peel through the leaf of Cordaites, *an extinct relative of living conifers showing extremely fine preservation of the internal tissues. The leaf would have been about 1 mm thick. Middle Pennsylvanian, Lovilia, Iowa. (Photo courtesy R. W. Baxendale.)*

but perhaps had an even more fundamental effect on the "nitty-gritty" of how paleobotany was done. The subject was transformed from one of arms-length contemplation to one which came to grips with fossil plants and sought to extract information from even the scruffiest and most unpromising material. The technique did however have a major weakness: simply that much of the fossil plant and much critical information was lost during the cutting and grinding of preparation. It was totally impossible to prepare a series of closely spaced "serial" sections through a single specimen. Such series are crucial to an accurate three-dimensional reconstruction of the fossil plant.

These problems were solved by James Walton, who developed a new and elegant technique which he first described in a brief paper in *Nature* in 1928. Walton was the first to recognize the importance of a simple fact: if a smooth surface of a petrifaction is etched with dilute acid, then the acid preferentially dissolves only the rock matrix, leaving tiny ridges of the plant cell walls protruding from the surface. For calcareous coal balls, dilute hydrochloric acid is used for etching, and the plant cell walls are almost unaffected by this treatment. Walton then poured a thin layer of a cellulose-based liquid onto the etched surface. This dried into a thin, flexible film to which the cell walls projecting from the etched surface became attached. The film could then be "peeled" from the rock surface, bringing with it the cell walls, and preserving the fine details of the tissues, cells, and occasionally even subcellular details of the petrified fossil plants.

Walton's technique was based on the simplest of observations, but it was a major advance in paleobotanical technique, which revolutionized the study of plant petrifactions. The "peel technique," as it came to be called, was further modified in 1956 by the introduction of cellulose-acetate sheet. Instead of pouring the peels in liquid form, the etched surface is flooded with acetone, and the cellulose-acetate sheet is carefully lowered into position. The acetone dissolves the lower surface of the sheet and allows it to become attached to the projecting cell walls before being peeled in the customary way. The effect of this modification was to permit a peel to be taken from the same specimen every twenty minutes, rather than once a day with the poured method.

The modified peel technique is the basis for our detailed understanding of many fossil plants, and has been adapted and refined to allow the extraction of spores and other plant parts for scanning or transmission electron microscopy. It has also been used to study petrifactions in silica and iron pyrite where hydrofluoric or nitric acids are used for etching. Whatever the matrix, the peel technique is uniformly straightforward, and its elegant simplicity has a fascination all its own. From the botanical perspective it gives us the inside story on ancient fossil plants, providing some of our most useful insights into the life and times of plants of the past. □



Fossil spore (Elaterites triferens) *extracted from a Middle Pennsylvanian coal ball by R. W. Baxter, University of Kansas. This spore was produced by a plant similar to living horsetails (scouring rushes,* Equisetum). *In living spores the construction of the appendages (elaters) makes them curl and uncurl in response to changes in humidity. This may contribute to efficient dispersal. The three elaters on this fossil spore were still capable of this response after fossilization for over 300 million years. What Cheer, Iowa. (Photo courtesy R. W. Baxendale.)*

Continued from p. 9

High-fired glazed ceramics were first made by the Chinese in the early Bronze Age. By the Song dynasty (960-1279) the long, continuous development of ceramics culminated in some of the finest works of art ever produced in this medium. The union of refined glaze and body material, highly skilled craftsmanship, and a sophisticated and serene aesthetic sensibility can be seen at left in the unusual Yaozhou vase with three feet. Yaozhou, in Shaanxi Province, was an important center of ceramic production in the north. During the Song dynasty, Yaozhou was known chiefly for the manufacture of celadons (ceramic ware notable for pale blue to pale greenish color) with carved decoration. The vase has a round body tapering gradually upward toward the nearly cylindrical neck. The neck is decorated with two rows of carved petals, the lower part of the body with a large leaf scroll. The soft greyish-green glaze, pooling into the carved recesses, enhances the decoration. The vase is supported on three animal feet that issue from the mouth of three leonine heads attached to the lower part of the body.

The square ding, *right, was carved from a single rhinoceros horn during the Qing dynasty (1644-1911 A.D.). It was modelled after bronze prototypes of the Shang and Zhou dynasties, has straight ears, a deep belly, and rests on four flattened legs. Fretwork surrounds the rim; dragons and animal masks ornament the body, while dragon designs decorate the foot. The magnificent decoration is distinguished for its virtuosity. Height: 18.4 cm. (7¼ in.).*

The rectangular pillow at left, with polychrome decoration of a phoenix in flight, is an example of Cizhou type ware, a popular ceramic ware manufactured at numerous kilns in northern China from the Northern Song dynasty (960-1127) on. The distinguishing characteristic of this large group of ceramics is the use of a dressing of white slip on the clay body. Many different methods were employed in the decoration of Cizhou type ware. On this pillow, the outlines of the decoration have been incised into the white slip, and the areas within the lines have been filled with green, red, and yellow lead glaze. Ceramic pillows were quite widely used from the Song through the Yuan dynasties. This one, dating from the Jin dynasty (1115-1234), is impressive for its brilliant coloring and unusual size.

The manufacture of blue-and-white porcelain—porcelain painted under the glaze with cobalt blue pigment—is believed to have begun in the Song dynasty (960-1127). The Yuan dynasty meiping, *a type of vase (left), has a high, rounded shoulder and nearly straight sides that taper toward the foot. The ornament is arranged in three principal bands. In the upper band, four "cloud collar" windows enclose egrets and mandarin ducks among lotuses on a ground of overlapping waves. In the middle band are large peony blossoms among scrolling branches and leaves, and around the lower part of the vase is a row of lotus petal panels. Such fine porcelains are known to be the product of kilns in Jingdezhen, Jiangxi Province. The Jingdezhen kilns emerged as the foremost center of porcelain manufacture in China during the Yuan dynasty and continued to hold this position until modern times.*

The Shanghai Museum's outstanding collection of paintings is represented in the exhibition by thirty-eight masterpieces from the Ming (1368-1644) and Qing (1644-1911) dynasties. This is the first time that master paintings from the People's Republic of China have been exhibited in the United States. Of these, the painting "Chrysanthemums and Rocks," by Yun Shouping, is a fascinating study in contrasting techniques and styles of Chinese painting. A highly accomplished artist, Yun Shouping was acclaimed as the greatest flower painter of his generation. He is considered one of the six Orthodox Masters of the early Qing dynasty. The chrysanthemums in this work are painted in bright colors without the use of ink outlines, a method known in China as "boneless." Close attention is given to detailed, accurate representation and subtle shadings of color. The rocks, on the other hand, are painted in ink only, their crumbly forms depicted with sparsely applied short strokes and dabs of the brush. Their rough, sketchy quality makes the polished elegance of the chrysanthemums all the more striking. At the top of the painting, the artist has inscribed a poem of his own composition:

Confronting these yellow flowers, I am silent and speechless.
The flowers' branches reach toward me as though with affection.
Each leaf of the lean stalk carries the breath of frost.
Each petal of the numerous flowers holds the brightness of autumn.

TOURS FOR MEMBERS

Alaska Natural History Tour

June 1984

Experience the Great Land. Descriptions of Alaska are filled with superlatives—a state more than twice the size of Texas with a population less than that of Denver, 33,000 miles of coastline, 119 million acres of forest, 14 of the highest peaks in the United States culminating in Mt. Denali (formerly Mt. McKinley), at 20,320 feet, the highest in North America. Alaska is equally a land of wildlife superlatives, from her great herds of caribou to swarming seabird rookeries to surging salmon in migration. When one thinks of Alaska one thinks of wilderness, of nature still fresh and undomesticated, of experiences dreamed of but mostly unavailable to us of the lower 48.

Join us in June 1984 for an Alaskan odyssey through a wide range of habitats from the rockbound fur seal and sea bird colonies of the Pribilofs, to the dripping forest and calving glaciers of the southeast, to the grandeur of the Alaskan Range, to the fjordlike quiet and beauty of the inland passage. Experience Alaska as few have.

Our travels will be by plane, train, bus, boat, horseback, and foot—whatever best enhances our experience. Emphasis will be on the land, its history, its wildlife. Interpretation combined with direct observation will provide an enjoyment and quality of experience unavailable to the casual visitor. Whatever your interest in natural history—marine mammals, birding, mountains, photography, flowers, forests, glaciers, icebergs, rivers—this tour will show you Alaska in all its diversity and splendor.

The tour will be led by Dr. Robert Karl Johnson, Chairman of the Department of Zoology of Field Museum.

Exact dates and rate will be announced. Please call or write to be placed on mailing list.

Costa Rica

January 14-27

$2,000

Visit San Jose, Cartago, Port Limon, Puerto Viego, Port of Puntarenas, Monteverde Forest Preserve and Cloud Forest, and more. This tour will give you an opportunity to explore in depth the plants and edible fruits of this country plus many opportunities for photographing.

Dr. William C. Burger, curator and chairman of Field Museum's Botany Department, has been on nine collecting trips to Costa Rica, and visited many areas of the country. In addition to his interests in flowers and floras, Dr. Burger has been an avid amateur photographer for more than 30 years. Tom Economou, horticulturist and botanical plant explorer will also join our group as co-leader.

Tropical Marine Biology

Exploration of Isla Roatan

February 15-24

$1,450

Crystal clear water, magnificent coral reefs, and a fantastic diversity of marine life are characteristics of the coast of Roatan, the largest of the Bay Islands in the Gulf of Honduras and some 30 miles off the Central American coast. Field Museum will conduct a 10-day tour to Roatan especially for divers that will combine superlative diving, expert instruction in marine natural history, and an opportunity to observe or actively participate in the scientific collecting of fishes.

An outstanding attraction for divers is spectacular "drop-offs" whose tops extend into depths as shallow as 25 feet. Leading the tour will be two ichthyologists with more than 10 years experience in the Caribbean as teachers, divers, and researchers: Dr. Robert Karl Johnson, curator of fishes and chairman of Field Museum's Department of Zoology; and Dr. David W. Greenfield, professor of biological sciences and associate dean of the Graduate School at Northern Illinois University. Illustrated talks about marine ecosystems will be combined with field trips to observe habitat types.

Accommodations will be at the Reef House diving resort on Roatan. The all-inclusive price of $1,450 covers all travel, lodging, and meals at the Reef House, and two or three tank dives per day. An early indication of interest is suggested.

Egypt

Wonders of the Nile

January 31-February 16, 1984

An unforgettable in-depth visit to the Land of the Pharaohs, including an 8-day Nile cruise aboard the luxurious *Sheraton Nile Steamer.* The tour leader is Dr. Bruce Williams, a distinguished U.S. Egyptologist. Dr. Williams is an expert in archaeology and ancient history, and has recently helped develop a fascinating new theory on the origins of the Egyptian state. He will travel with the tour throughout, including the Nile cruise, and personally conduct all lectures and sightseeing. Highlights of our tour will be the pyramids and Sphinx of Giza, little-visited monuments of Middle Egypt, King Tut's tomb, the holiday resort of Aswan, and a visit to Abu Simbel.

For additional information on any tour, please call Tours Manager Dorothy Roder at 322-8862 or write Field Museum Tours, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.

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December 1983

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December 1983
Volume 54, Number 11

The Scientist as Photographer

Appointment Calendar Featuring the Photographic Art of Field Museum Curators Steven Ashe, William Burger, and Edward Olsen

COVER

Mt. Athabaska from ridge north of ice fields, Jasper National Park, Alberta, Canada. Photo by Steven Ashe, assistant curator of insects.

THE SCIENTIST AS PHOTOGRAPHER

The one indispensable tool of the natural history curator in the field, whatever his discipline, may well be the camera, a basically simple, but increasingly sophisticated device that provides a refinement, an extension, an enhancement of his already considerable powers of vision and memory.

The camera may also be unique, among the tools of science, as an instrument of pleasure; for the art of picture-taking is surely as gratifying, for those with aesthetic ends in view, as the technology of photography is intriguing to the engineer or the scientist.

The photos featured in this year's calendar are a pleasurable mix of science and art—all the work of Field Museum curators while going about their various appointed tasks in the field. They were chosen for their success in pleasing the eye as much as for their intrinsic scientific merit.

William Burger, chairman of Field Museum's Department of Botany, took the photos accompanying the months of March and October. Edward Olsen, curator of mineralogy, took the January, July, and September photos. The remaining seven—for February, April, May, June, August, November, and December—were taken by Steven Ashe, assistant curator of insects, who also took the cover photo. □

JANUARY 1984

King penguins on South Georgia Island. Photo by Edward Olsen.

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 NEW YEAR'S DAY Museum closed sunrise: 7:18am sunset: 4:31pm	**2** ● *new moon* sunrise: 7:18am sunset: 4:31pm	**3** *Earth closest to Sun (perihelion): 91.4 million miles* sunrise: 7:18am sunset: 4:32pm	**4** sunrise: 7:18am sunset: 4:33pm	**5** sunrise: 7:18am sunset: 4:34pm	**6** Epiphany sunrise: 7:18am sunset: 4:35pm	**7** sunrise: 7:18am sunset: 4:36pm
8 sunrise: 7:18am sunset: 4:37pm	**9** sunrise: 7:17am sunset: 4:38pm	**10** sunrise: 7:17am sunset: 4:39pm	**11** ◐ *first quarter* sunrise: 7:17am sunset: 4:40pm	**12** sunrise: 7:17am sunset: 4:41pm	**13** sunrise: 7:16am sunset: 4:43pm	**14** sunrise: 7:16am sunset: 4:44pm
15 Martin Luther King's Birthday sunrise: 7:16am sunset: 4:45pm	**16** sunrise: 7:15am sunset: 4:46pm	**17** sunrise: 7:15am sunset: 4:47pm	**18** ○ *full moon* sunrise: 7:14am sunset: 4:48pm	**19** sunrise: 7:13am sunset: 4:50pm	**20** sunrise: 7:13am sunset: 4:51pm	**21** sunrise: 7:12am sunset: 4:52pm
22 sunrise: 7:12am sunset: 4:53pm	**23** sunrise: 7:11am sunset: 4:54pm	**24** ◑ *last quarter* sunrise: 7:10am sunset: 4:56pm	**25** sunrise: 7:09am sunset: 4:57pm	**26** sunrise: 7:09am sunset: 4:58pm	**27** sunrise: 7:08am sunset: 4:59pm	**28** sunrise: 7:07am sunset: 5:01pm
29 sunrise: 7:06am sunset: 5:02pm	**30** sunrise: 7:05am sunset: 5:03pm	**31** sunrise: 7:04am sunset: 5:04pm		*Capricorn Dec. 22-Jan. 19* *Aquarius Jan. 20-Feb.18* Times for sunrise and sunset are for Chicago, Central Standard Time.		

DECEMBER 1983

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
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FEBRUARY

S	M	T	W	T	F	S
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19	20	21	22	23	24	25
26	27	28	29			

FEBRUARY 1984

Joshua trees at sunrise. Photo by Steven Ashe.

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		Aquarius Jan. 20-Feb.18 *Pisces Feb.19-March 20*	**1** ● *new moon* sunrise 7:03am sunset 5:06pm	**2** GROUNDHOG DAY sunrise 7:02am sunset 5:07pm	**3** sunrise 7:01am sunset 5:08pm	**4** sunrise 7:00am sunset 5:10pm
5 sunrise 6:59am sunset 5:11pm	**6** sunrise 6:58am sunset 5:12pm	**7** sunrise 6:57am sunset 5:13pm	**8** sunrise 6:55am sunset 5:15pm	**9** ◐ *first quarter* sunrise 6:54am sunset 5:16pm	**10** sunrise 6:53am sunset 5:17pm	**11** sunrise 6:52am sunset 5:19pm
12 LINCOLN'S BIRTHDAY sunrise 6:50am sunset 5:20pm	**13** sunrise 6:49am sunset 5:21pm	**14** ST. VALENTINE'S DAY sunrise 6:48am sunset 5:22pm	**15** sunrise 6:47am sunset 5:24pm	**16** ○ *full moon* sunrise 6:45am sunset 5:25pm	**17** sunrise 6:44am sunset 5:26pm	**18** sunrise 6:42am sunset 5:27pm
19 sunrise 6:41am sunset 5:29pm	**20** PRESIDENT'S DAY sunrise 6:40am sunset 5:30pm	**21** sunrise 6:38am sunset 5:31pm	**22** sunrise 6:37am sunset 5:32pm	**23** ◑ *last quarter* sunrise 6:35am sunset 5:33pm	**24** sunrise 6:34am sunset 5:35pm	**25** sunrise 6:32am sunset 5:36pm
26 sunrise 6:31am sunset 5:37pm	**27** sunrise 6:29am sunset 5:38pm	**28** sunrise 6:27am sunset 5:39pm	**29** sunrise 6:27am sunset 5:40pm	Times for sunrise and sunset are for Chicago, Central Standard Time.		

JANUARY

S	M	T	W	T	F	S
1	2	3	4	5	6	7
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15	16	17	18	19	20	21
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29	30	31				

MARCH

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
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25	26	27	28	29	30	31

MARCH 1984

Mushrooms (Coprinus micaceus) *with jewelweed* (Impatiens). *Photo by William Burger.*

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
FEBRUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	**APRIL** S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30		*Pisces* *Feb.19-March 20* *Aries* *March 21-April 19* Times for sunrise and sunset are for Chicago, Central Standard Time.	**1** sunrise 6:26am sunset 5:41pm	**2** ● *new moon* sunrise 6:24am sunset 5:42pm	**3** sunrise 6:23am sunset 5:43pm
4 sunrise 6:21am sunset 5:44pm	**5** sunrise 6:20am sunset 5:45pm	**6** SHROVE TUESDAY sunrise 6:18am sunset 5:47pm	**7** ASH WEDNESDAY sunrise 6:16am sunset 5:48pm	**8** sunrise 6:15am sunset 5:49pm	**9** sunrise 6:13am sunset 5:50pm	**10** ◐ *first quarter* sunrise 6:11am sunset 5:51pm
11 sunrise 6:10am sunset 5:52pm	**12** sunrise 6:08am sunset 5:53pm	**13** sunrise 6:06am sunset 5:55pm	**14** sunrise 6:05am sunset 5:56pm	**15** IDES OF MARCH sunrise 6:03am sunset 5:57pm	**16** sunrise 6:01am sunset 5:58pm	**17** ST. PATRICK'S DAY ○ *full moon* sunrise 6:00am sunset 5:59pm
18 PURIM sunrise 5:58am sunset 6:00pm	**19** sunrise 5:56am sunset 6:01pm	**20** first day of spring sunrise 5:54am sunset 6:02pm	**21** sunrise 5:53am sunset 6:04pm	**22** sunrise 5:51am sunset 6:05pm	**23** sunrise 5:49am sunset 6:06pm	**24** ◑ *last quarter* sunrise 5:48am sunset 6:07pm
25 sunrise 5:46am sunset 6:08pm	**26** sunrise 5:44am sunset 6:09pm	**27** sunrise 5:43am sunset 6:10pm	**28** sunrise 5:41am sunset 6:11pm	**29** sunrise 5:39am sunset 6:12pm	**30** sunrise 5:37am sunset 6:13pm	**31** sunrise 5:36am sunset 6:15pm

APRIL 1984

Rocky Mountain goats by Sunwapta River, Alberta. Photo by Steven Ashe.

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 ● *new moon* sunrise 5:34am sunset 6:16pm	**2** sunrise 5:32am sunset 6:17pm	**3** sunrise 5:31am sunset 6:18pm	**4** sunrise 5:29am sunset 6:19pm	**5** sunrise 5:27am sunset 6:20pm	**6** sunrise 5:26am sunset 6:21pm	**7** sunrise 5:24am sunset 6:22pm
8 ◐ *first quarter* sunrise 5:22am sunset 6:23pm	**9** sunrise 5:21am sunset 6:24pm	**10** sunrise 5:19am sunset 6:25pm	**11** sunrise 5:17am sunset 6:27pm	**12** sunrise 5:16am sunset 6:28pm	**13** sunrise 5:14am sunset 6:29pm	**14** sunrise 5:13am sunset 6:30pm
15 PALM SUNDAY ○ *full moon* sunrise 5:11am sunset 6:31pm	**16** sunrise 5:09am sunset 6:32pm	**17** PASSOVER sunrise 5:08am sunset 6:33pm	**18** sunrise 5:06am sunset 6:34pm	**19** sunrise 5:05am sunset 6:35pm	**20** GOOD FRIDAY sunrise 5:03am sunset 6:36pm	**21** sunrise 5:02am sunset 6:37pm
22 EASTER ◑ *last quarter* sunrise 5:00am sunset 6:39pm	**23** sunrise 4:59am sunset 6:40pm	**24** sunrise 4:57am sunset 6:41pm	**25** sunrise 4:56am sunset 6:42pm	**26** sunrise 4:54am sunset 6:43pm	**27** sunrise 4:53am sunset 6:44pm	**28** sunrise 4:52am sunset 6:45pm
29 sunrise 4:50am sunset 6:46pm	**30** ● *new moon* sunrise 4:49am sunset 6:47pm	*Aries* March 21-April 19 *Taurus* April 20-May 20 Times for sunrise and sunset are for Chicago, Central Standard Time. For Daylight Savings Time add 1 hour.				

MARCH

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MAY

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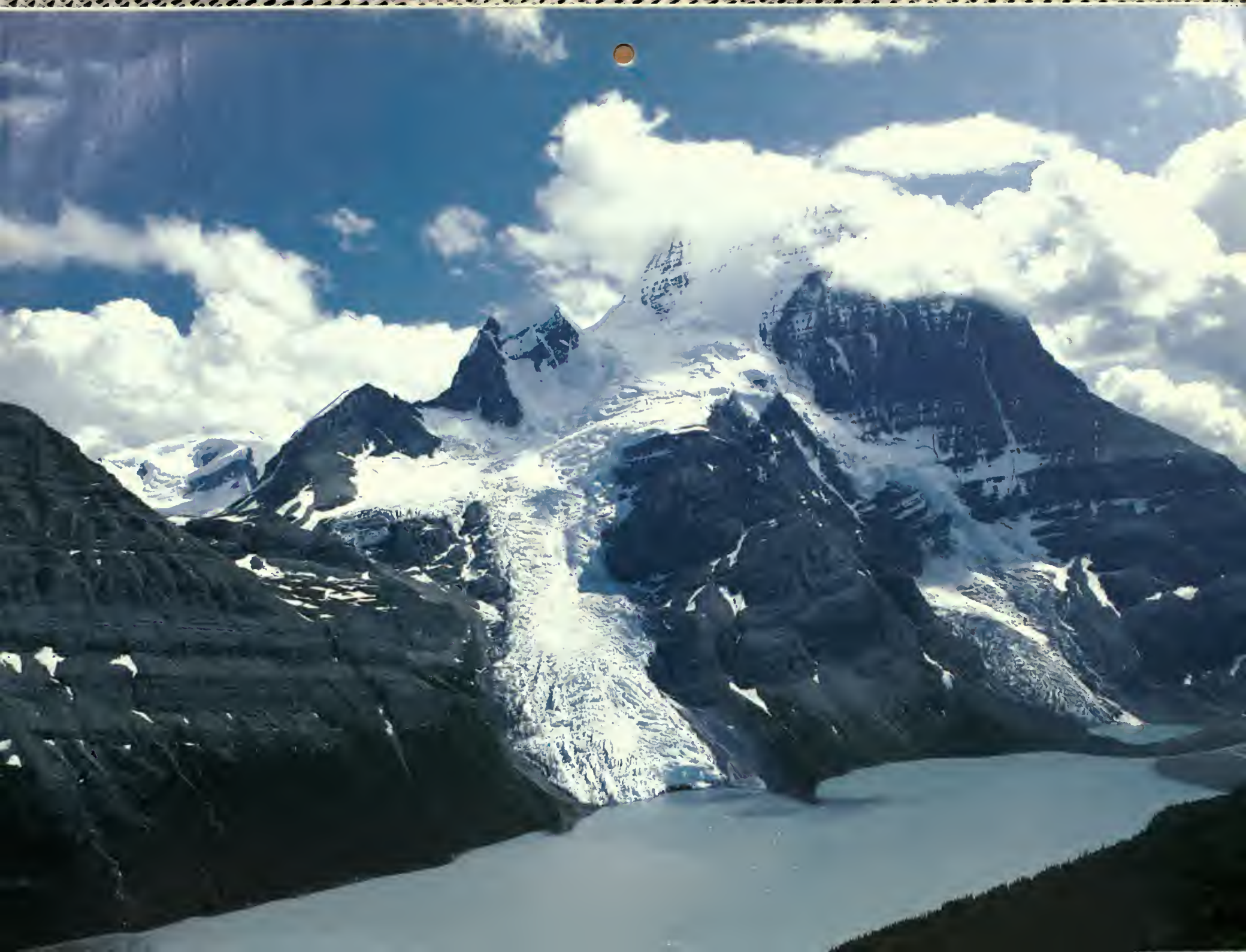
20	21	22	23	24	25	26
27	28	29	30	31		



MAY 1984

Mt. Robson and Berg Lake, Alberta. Photo by Steven Ashe.

FIELD MUSEUM OF NATURAL HISTORY

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY

APRIL

S	M	T	W	T	F	S
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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

JUNE

S	M	T	W	T	F	S
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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

	1 sunrise 4:48am sunset 6:48pm	**2** Field Museum opened 1921 (Grant Park) sunrise 4:46am sunset 6:49pm	**3** sunrise 4:45am sunset 6:51pm	**4** sunrise 4:44am sunset 6:52pm	**5** sunrise 4:42am sunset 6:53pm
6 sunrise 4:41am sunset 6:54pm	**7** sunrise 4:40am sunset 6:55pm	**8** ◐ *first quarter* sunrise 4:39am sunset 6:56pm	**9** sunrise 4:38am sunset 6:57pm	**10** sunrise 4:36am sunset 6:58pm	**11** sunrise 4:35am sunset 6:59pm	**12** sunrise 4:34am sunset 7:00pm
13 MOTHER'S DAY sunrise 4:33am sunset 7:01pm	**14** ○ *full moon* sunrise 4:32am sunset 7:02pm	**15** penumbral eclipse of moon sunrise 4:31am sunset 7:03pm	**16** sunrise 4:30am sunset 7:04pm	**17** sunrise 4:29am sunset 7:05pm	**18** sunrise 4:28am sunset 7:06pm	**19** sunrise 4:27am sunset 7:07pm
20 sunrise 4:26am sunset 7:08pm	**21** sunrise 4:26am sunset 7:09pm	**22** ◑ *last quarter* sunrise 4:25am sunset 7:10pm	**23** sunrise 4:24am sunset 7:11pm	**24** sunrise 4:23am sunset 7:12pm	**25** sunrise 4:23am sunset 7:13pm	**26** sunrise 4:22am sunset 7:14pm
27 sunrise 4:21am sunset 7:14pm	**28** MEMORIAL DAY sunrise 4:21am sunset 7:15pm	**29** sunrise 4:20am sunset 7:16pm	**30** annular eclipse of sun ● *new moon* sunrise 4:19am sunset 7:17pm	**31** ASCENSION sunrise 4:19am sunset 7:18pm	*Taurus* *April 20-May 20* *Gemini* *May 21-June 21* Times for sunrise and sunset are for Chicago, Central Standard Time. For Daylight Savings Time add 1 hour.	

JUNE 1984

Rocky Mountain white heather (Cassiope tetragona) *and purple mountain heath* (Phyllodoce empetriformis). *Photo by Steven Ashe.*

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
MAY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	**JULY** S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31			*Gemini* *May 21-June 21* *Cancer* *June 22-July 22* Times for sunrise and sunset are for Chicago, Central Standard Time. For Daylight Savings Time add 1 hour.	**1** sunrise 4:18am sunset 7:18pm	**2** Field Museum opened 1894 (Jackson Park) sunrise 4:16am sunset 7:19pm
3 sunrise 4:16am sunset 7:20pm	**4** sunrise 4:17am sunset 7:21pm	**5** sunrise 4:17am sunset 7:21pm	**6** *first quarter* sunrise 4:17am sunset 7:22pm	**7** sunrise 4:16am sunset 7:23pm	**8** sunrise 4:16am sunset 7:23pm	**9** sunrise 4:16am sunset 7:24pm
10 PENTECOST sunrise 4:16am sunset 7:24pm	**11** sunrise 4:15am sunset 7:25pm	**12** sunrise 4:15am sunset 7:25pm	**13** penumbral eclipse of moon *full moon* sunrise 4:15am sunset 7:26pm	**14** FLAG DAY sunrise 4:15am sunset 7:26pm	**15** sunrise 4:15am sunset 7:27pm	**16** sunrise 4:15am sunset 7:27pm
17 FATHER'S DAY sunrise 4:15am sunset 7:27pm	**18** sunrise 4:15am sunset 7:28pm	**19** sunrise 4:15am sunset 7:28pm	**20** sunrise 4:15am sunset 7:28pm	**21** first day of summer *last quarter* sunrise 4:16am sunset 7:29pm	**22** sunrise 4:16am sunset 7:29pm	**23** sunrise 4:16am sunset 7:29pm
24 sunrise 4:17am sunset 7:29pm	**25** sunrise 4:17am sunset 7:29pm	**26** sunrise 4:17am sunset 7:29pm	**27** sunrise 4:18am sunset 7:29pm	**28** *new moon* sunrise 4:16am sunset 7:29pm	**29** sunrise 4:18am sunset 7:29pm	**30** sunrise 4:19am sunset 7:29pm

JULY 1984

Killer whale takes breather through Antarctic ice. Photo by Edward Olsen.

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 sunrise 4:19am sunset 7:29pm	**2** sunrise 4:20am sunset 7:29pm	**3** Sun furthest from Earth (94.5 million miles away) sunrise 4:20am sunset 7:29pm	**4** **INDEPENDENCE DAY** sunrise 4:21am sunset 7:28pm	**5** ◐ *first quarter* sunrise 4:22am sunset 7:28pm	**6** sunrise 4:22am sunset 7:28pm	**7** sunrise 4:23am sunset 7:27pm
8 sunrise 4:23am sunset 7:27pm	**9** sunrise 4:24am sunset 7:27pm	**10** sunrise 4:25am sunset 7:26pm	**11** sunrise 4:26am sunset 7:26pm	**12** ○ *full moon* sunrise 4:26am sunset 7:25pm	**13** sunrise 4:27am sunset 7:25pm	**14** sunrise 4:28am sunset 7:24pm
15 sunrise 4:29am sunset 7:24pm	**16** sunrise 4:29am sunset 7:23pm	**17** sunrise 4:30am sunset 7:22pm	**18** sunrise 4:31am sunset 7:22pm	**19** sunrise 4:32am sunset 7:21pm	**20** ◑ *last quarter* sunrise 4:33am sunset 7:20pm	**21** sunrise 4:34am sunset 7:19pm
22 sunrise 4:35am sunset 7:19pm	**23** sunrise 4:36am sunset 7:18pm	**24** sunrise 4:37am sunset 7:17pm	**25** sunrise 4:37am sunset 7:16pm	**26** sunrise 4:38am sunset 7:15pm	**27** sunrise 4:39am sunset 7:14pm	**28** ● *new moon* sunrise 4:40am sunset 7:13pm
29 sunrise 4:41am sunset 7:12pm	**30** sunrise 4:42am sunset 7:11pm	**31** sunrise 4:43am sunset 7:10pm	*Cancer* *June 22-July 22* *Leo* *July 23-Aug. 22* Times for sunrise and sunset are for Chicago Central Standard Time. Daylight Savings Time add 1 hour.		**JUNE** S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	**AUGUST** S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

AUGUST 1984

White-flowered mountain avens (Dryas hookeriana). *Photo by Steven Ashe.*

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JULY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	**SEPTEMBER** S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30		**1** sunrise 4:44am sunset 7:09pm	**2** sunrise 4:45am sunset 7:08pm	**3** ◐ *first quarter* sunrise 4:46am sunset 7:06pm	**4** sunrise 4:47am sunset 7:05pm
5 sunrise 4:48am sunset 7:04pm	**6** sunrise 4:49sm sunset 7:03pm	**7** sunrise 4:50am sunset 7:02pm	**8** sunrise 4:51am sunset 7:00pm	**9** sunrise 4:52am sunset 6:59pm	**10** sunrise 4:53am sunset 6:58pm	**11** ○ *full moon* sunrise 4:54am sunset 6:56pm
12 sunrise 4:55am sunset 6:55pm	**13** sunrise 4:56am sunset 6:54pm	**14** sunrise 4:57sm sunset 6:52pm	**15** sunrise 4:58am sunset 6:51pm	**16** sunrise 4:59em sunset 6:49pm	**17** sunrise 5:01am sunset 6:46pm	**18** sunrise 5:02am sunset 6:46pm
19 ◑ *last quarter* sunrise 5:03am sunset 6:45pm	**20** sunrise 5:04am sunset 6:43pm	**21** sunrise 5:05am sunset 6:42pm	**22** sunrise 5:06am sunset 6:40pm	**23** sunrise 5:07am sunset 6:39pm	**24** sunrise 5:08am sunset 6:37pm	**25** sunrise 5:09am sunset 6:36pm
26 ● *new moon* sunrise 5:10am sunset 6:34pm	**27** sunrise 5:11am sunset 6:33pm	**28** sunrise 5:12am sunset 6:31pm	**29** sunrise 5:13am sunset 6:29pm	**30** sunrise 5:14am sunset 6:28pm	**31** sunrise 5:15am sunset 6:26pm	*Leo* *July 23-Aug. 22* *Virgo* *Aug. 23-Sept. 22* Times for sunrise and sunset are for Chicago, Central Standard Time. For Daylight Savings Time add 1 hour.

SEPTEMBER 1984

Antarctic Peninsula, Lamaire Channel. Photo by Edward Olsen.

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
AUGUST S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	**OCTOBER** S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31				*Virgo* *Aug. 23-Sept. 22* *Libra* *Sept. 23-Oct. 22* Times for sunrise and sunset are for Chicago, Central Standard Time.	**1** sunrise 5:16am sunset 6:24pm
2 ◑ *first quarter* sunrise 5:17am sunset 6:23pm	**3** LABOR DAY sunrise 5:18am sunset 6:21pm	**4** sunrise 5:19am sunset 6:19pm	**5** sunrise 5:20am sunset 6:18pm	**6** sunrise 5:21am sunset 6:16pm	**7** sunrise 5:22am sunset 6:14pm	**8** sunrise 5:23am sunset 6:13pm
9 sunrise 5:24am sunset 6:11pm	**10** ○ *full moon* sunrise 5:25am sunset 6:09pm	**11** sunrise 5:26am sunset 6:07pm	**12** sunrise 5:27am sunset 6:06pm	**13** sunrise 5:28am sunset 6:04pm	**14** sunrise 5:29am sunset 6:02pm	**15** sunrise 5:30am sunset 6:00pm
16 Field Museum founded 1893 sunrise 5:31am sunset 5:59pm	**17** sunrise 5:32am sunset 5:57pm	**18** ◑ *last quarter* sunrise 5:33am sunset 5:55pm	**19** sunrise 5:34am sunset 5:54pm	**20** sunrise 5:35am sunset 5:52pm	**21** sunrise 5:36am sunset 5:50pm	**22** first day of fall sunrise 5:38am sunset 5:48pm
23 sunrise 5:39am sunset 5:47pm	**24** ● *new moon* sunrise 5:40am sunset 5:45pm	**25** sunrise 5:41am sunset 5:43pm	**26** sunrise 5:42am sunset 5:41pm	**27** ROSH HASHANA ISLAMIC NEW YEAR sunrise 5:43am sunset 5:40pm	**28** sunrise 5:44am sunset 5:38pm	**29** sunrise 5:45am sunset 5:36pm
30 sunrise 5:46am sunset 5:35pm						

OCTOBER 1984

Pair of mallard ducks. Photo by William Burger.

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Libra Sept. 23-Oct. 22 *Scorpio* Oct. 23-Nov. 21 Times for sunrise and sunset are for Chicago, Central Standard Time. For Daylight Savings Time add 1 hour.	**1** ◐ *first quarter* sunrise 5:47am sunset 5:33pm	**2** sunrise 5:48am sunset 5:31pm	**3** sunrise 5:49am sunset 5:29pm	**4** sunrise 5:50am sunset 5:28pm	**5** sunrise 5:51am sunset 5:26pm	**6** YOM KIPPUR sunrise 5:52am sunset 5:24pm
7 sunrise 5:53am sunset 5:23pm	**8** COLUMBUS DAY sunrise 5:55am sunset 5:21pm	**9** ○ *full moon* sunrise 5:56am sunset 5:19pm	**10** sunrise 5:57am sunset 5:18pm	**11** sunrise 5:58am sunset 5:18pm	**12** sunrise 5:59am sunset 5:15pm	**13** sunrise 6:00am sunset 5:13pm
14 sunrisa 6:01am sunset 5:11pm	**15** sunrise 6:02am sunset 5:10pm	**16** sunrise 6:03am sunset 5:08pm	**17** ◑ *last quarter* sunrise 6:05am sunset 5:07pm	**18** sunrise 6:06am sunset 5:05pm	**19** sunrise 6:07am sunset 5:04pm	**20** sunrise 6:08am sunset 5:02pm
21 sunrise 6:09am sunset 5:01pm	**22** sunrise 6:10am sunset 4:59pm	**23** sunrise 6:12am sunset 4:56pm	**24** U.N. DAY ● *new moon* sunrise 6:13am sunset 4:56pm	**25** sunrise 6:14am sunset 4:55pm	**26** sunrise 6:15am sunset 4:53pm	**27** sunrise 6:16am sunset 4:52pm
28 sunrise 6:17am sunset 4:51pm	**29** sunrise 6:19am sunset 4:49pm	**30** sunrise 6:20am sunset 4:48pm	**31** HALLOWEEN ◐ *first quarter* sunrise 6:21am sunset 4:47pm			

SEPTEMBER

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

NOVEMBER

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

NOVEMBER 1984

Bighorn sheep, Jasper National Park, Alberta. Photo by Steven Ashe.

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
OCTOBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	**DECEMBER** S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31			**1** sunrise 6:22am sunset 4:45pm	**2** sunrise 6:24am sunset 4:44pm	**3** sunrise 6:25am sunset 4:43pm
4 sunrise 6:26am sunset 4:42pm	**5** sunrise 6:27am sunset 4:41pm	**6** GENERAL ELECTION DAY sunrise 6:28am sunset 4:39pm	**7** sunrise 6:30am sunset 4:38pm	**8** penumbral eclipse of moon ○ *full moon* sunrise 6:31am sunset 4:37pm	**9** sunrise 6:32am sunset 4:36pm	**10** sunrise 6:33am sunset 4:35pm
11 VETERAN'S DAY sunrise 6:35am sunset 4:34pm	**12** sunrise 6:36am sunset 4:33pm	**13** sunrise 6:37am sunset 4:32pm	**14** sunrise 6:38am sunset 4:31pm	**15** sunrise 6:39am sunset 4:30pm	**16** ◑ *last quarter* sunrise 6:41am sunset 4:30pm	**17** sunrise 6:42am sunset 4:29pm
18 sunrise 6:43am sunset 4:28pm	**19** sunrise 6:44am sunset 4:27pm	**20** sunrise 6:45am sunset 4:27pm	**21** sunrise 6:47am sunset 4:26pm	**22** **Thanksgiving** Museum closed ● *new moon* sunrise 6:48am sunset 4:25pm	**23** sunrise 6:49am sunset 4:25pm	**24** sunrise 6:50am sunset 4:24pm
25 sunrise 6:51am sunset 4:23pm	**26** sunrise 6:52am sunset 4:23pm	**27** sunrise 6:54am sunset 4:22pm	**28** sunrise 6:55am sunset 4:22pm	**29** sunrise 6:56am sunset 4:22pm	**30** ◐ *first quarter* sunrise 6:57am sunset 4:21pm	*Scorpio* *Oct. 23-Nov. 21* *Sagittarius* *Nov. 22-Dec. 21* Times for sunrise and sunset are for Chicago, Central Standard Time.

DECEMBER 1984

Grand Canyon.
Photo by Steven Ashe.

FIELD MUSEUM OF NATURAL HISTORY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
NOVEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	**JANUARY 1985** S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31				*Sagittarius* *Nov. 22-Dec. 21* *Capricorn* *Dec. 22-Jan. 19* Times for sunrise and sunset are for Chicago, Central Standard Time.	**1** sunrise 6:58am sunset 4:21pm
2 ADVENT sunrise 6:59am sunset 4:21pm	**3** sunrise 7:00am sunset 4:20pm	**4** sunrise 7:01am sunset 4:20pm	**5** sunrise 7:02am sunset 4:20pm	**6** sunrise 7:03am sunset 4:20pm	**7** sunrise 7:04am sunset 4:20pm	**8** ○ *full moon* sunrise 7:05am sunset 4:20pm
9 sunrise 7:06am sunset 4:20pm	**10** sunrise 7:07am sunset 4:20pm	**11** sunrise 7:07am sunset 4:20pm	**12** sunrise 7:08am sunset 4:20pm	**13** sunrise 7:09am sunset 4:20pm	**14** sunrise 7:10am sunset 4:21pm	**15** ◑ *last quarter* sunrise 7:11am sunset 4:21pm
16 sunrise 7:11am sunset 4:21pm	**17** sunrise 7:12am sunset 4:21pm	**18** sunrise 7:13am sunset 4:22pm	**19** HANUKKAH sunrise 7:13am sunset 4:22pm	**20** sunrise 7:14am sunset 4:23pm	**21** first day of winter sunrise 7:14am sunset 4:23pm	**22** ● *new moon* sunrise 7:15am sunset 4:24pm
23 sunrise 7:15am sunset 4:24pm **30** sunrise 7:17am sunset 4:29pm	**24** sunrise 7:16am sunset 4:25pm **31** sunrise 7:18am sunset 4:30pm	**25** CHRISTMAS Museum closed sunrise 7:16am sunset 4:25pm	**26** sunrise 7:16am sunset 4:26pm	**27** sunrise 7:17am sunset 4:27pm	**28** sunrise 7:17am sunset 4:27pm	**29** ◐ *first quarter* sunrise 7:17am sunset 4:28pm